AN ANALYSIS OF THE COMMERCIAL ASPECTS OF THE FISHING INDUSTRY OF GOA

Thesis submitted to
Goa University for the award of the Degree of
Doctor of Philosophy
in
Commerce

by

SANCHILIANA FARIA

under the Guidance of

Dr. MANOJ S. KAMAT
Principal
D.P.M.'s Shree Mallikarjun College, Canacona, Goa,
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Goa Business School
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2019

Dedicated to my dearest parents

late Mr. Roberto Francisco Xavier Faria

and Late Mrs. Felicia Rodrigues

and to my dear husband Mr. Nicolau Rodrigues.

DECLARATION

I, Ms. Sanchiliana Faria, hereby declare that the present thesis titled "**An Analysis of the Commercial Aspects of the Fishing Industry of Goa**" submitted to the Goa Business School, Goa University, Goa- India, for the award of the degree of Doctor of Philosophy is a bonafide record of original and independent research work done by me during the period 2014 to 2019. The study is carried out by me under the supervision and guidance of Dr. Manoj S. Kamat, Principal D.P.M.'s Shree Mallikarjun College of Arts and Commerce, Canacona, Goa and Research Guide, Research Centre, VVM's Shree Damodar College of Commerce & Economics, Margao-Goa. I also declare that this thesis has not been previously formed or presented, either wholly or partly as the basis for the award for any degree, diploma, associate-ship, fellowship or other similar titles of this or any other University. I have duly acknowledged all the sources of scholarly information used by me in this thesis.

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Place: Goa University

CERTIFICATE

This is to certify that the thesis titled, "**An Analysis of the Commercial Aspects of the Fishing Industry of Goa**" submitted by **Ms. Sanchiliana Faria** for the award of degree of Doctor of Philosophy in Commerce at Goa University, is the bonafide record of the original work done by her during the period of study under my supervision and guidance. This thesis has not previously formed the basis for the award of any degree, diploma, certificate, associateship, scholarship, fellowship or other similar titles of this or any other University.

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Ms. Sanchiliana Faria
Research Scholar

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LIST OF ABBREVIATIONS

ACMS	-	Arrow Chenery Minhas-Solow
APL	-	Above Poverty Line
BCR	-	Benefit Cost Ratio
BEP	-	Break Even Point
BPL	-	Below Poverty Line
CAGR	-	Compound Annual Growth Rate
CES	-	Constant Elasticity of Substitution
CIFT	-	Central Institute of Fisheries and Technology
CMFRI	-	Central Marine Fisheries Research Institute of India
DAHDF	-	Department of Animal Husbandry, Dairy and Fisheries
EMI	-	Equated Monthly Installments
FAO	-	Food and Agricultural Organization
FRP	-	Fibre Reinforced Plastic
GSDP	-	Gross State Domestic Product
GPS	-	Global Positioning System
GRE	-	Goencho Ramponkarancho Ekvott
GSDP	-	Goa State Domestic Product
IAS	-	International Accounting System
MFRA	-	Marine Fishing Regulation Act
MOS	-	Margin of Safety
MPEDA	-	Marine Products Exports Development Authority
MPF	-	Manual Propulsion Fisheries
NFDB	-	National Fisheries Development Board
OAL	-	Over All Length
OBC	-	Other Backward Class

OBM	-	Outboard Motors
OLS	-	Ordinary Least Square
RBI	-	Reserve Bank of India
ROI	-	Return on Investment
SC	-	Scheduled Caste
ST	-	Scheduled Tribe
TC	-	Total Cost
TR	-	Total Revenue
VAT	-	Value Added Tax
VHF	-	Very High Frequency
VIF	-	Variance Inflation Factor
VTS	-	Vessel Tracking System
WTO	-	World Trade Organization

Chapter 1

Introduction

Chapter 1

Introduction

1.1 Background of the Study

Fishing is one of the traditional occupations known to be older than agriculture dating back to the beginning of the upper Paleolithic period about 40,000 years ago. It is believed that hunting of fish was common in the prehistoric times. In the history of human civilization, both fisheries and agricultural farming expanded simultaneously. In earlier times of history, fish was considered as an important food. Fish is the staple food of many communities in the world. As an important economic activity of the world from among traditional activities, the fishing industry provides social security to millions of people, helping the socially and economically backward population. Although it belongs to the primary sector, it encompasses other ancillary and subsidiary activities, generating employment. In the first half of the 20th century, it was found that fish contains more amount of vitamin A and D (Whittle, 2011). Globally fish and fish products provide on average of 34 calories per day (Statista, 2018).

The world fisheries and aquaculture production is divided between (i) Capture; which includes marine and inland and (ii) Aquaculture; which comprises of marine and inland. Fish production from capture and aquaculture in the world which was 17 million tonnes in 1950, increased to 174 million tonnes in 2017. China is leading in the world fish production with 5,88,00,000 metric tonnes in 2017; and India occupies the second position with 69,45,892 metric tonnes in the same year (Statista, 2018). In 2016, India was the second largest aquaculture fish producing country and third largest in marine fish production after China. As one of the major sources of food, fisheries and aquaculture influence income levels, employment, nutrition, livelihood of the people and foreign exchange earnings in both developed and developing countries of the world. In 2016, 59.6 million people had been employed in the primary sector of capture fisheries and aquaculture with 19.3 million people in aquaculture and 40.3 million people in fisheries, providing livelihood to 10-12% of world's population. In 2016, 86% of the global population from Asia was employed in fisheries and aquaculture, followed by Africa 10%, Latin America and Caribbean

4%. The world's per capita fish supply which was 8 kg in 1950 increased to an estimated highest record of 20.5 kg in 2017. Fish production increased mainly because of the rapid growth in aquaculture (Statista, 2018).

1.1.1 Global View of the Fishing Industry

In the early 1950s, fisheries industry was in its onset and witnessed rapid development in both developing and developed nations. Food and Agriculture Organisation (FAO) reports highlight that the number of the fishery fleet has increased from 1950 till date and fishermen are using advanced technology, modern equipment and scientific methods across the globe for fishing. In 2014, Asia had the largest number of fleet consisting of 3.5 million vessels accounting for 75% of the global fleet. In 2016, the total number of fishing vessels were estimated to be 4.6 million. In Asia, Latin America, Caribbean and the Oceania the number of vessels increased largely due to the improvements in estimation procedures (Statistica, 2018). By 1990, mechanisation in the form of trawling, purse-seining and long-lining helped to exploit about 70% of the world's conventional fish species. However, mechanisation has resulted in overfishing, leading to overexploitation and affecting the sustainability of the fish resources. This has resulted in the dwindling of the fish catch for small-scale fishing communities and reduction in their income. Recent reports by FAO, the World Bank and other international organizations, as well as researchers, experts and representatives of the fishery industry, have highlighted the importance of the conservation of fish resources.

Fish and fish products are among the most traded food resources in the world, wherein a significant share of exports are provided by developing nations than the developed ones. Studies by World Bank, FAO and International Food Policy Research Institute (IFPRI) state that global trade in sea food is flowing from developing to developed countries. A study by FAO, (2012) has highlighted that 66.67% of sea food exports has moved from developing countries to developed countries. The share of fish and fish products at global level for human consumption has shown an upward trend and has increased from 11% in 1976 to 27% in 2016. The worldwide marine products exports in 2014 were 148 billion US dollars. In 2014, the exports of marine fishery products of the world in value terms was 1% of the global merchandise trade and nine percent of the total agricultural exports (The State of World Fisheries and Aquaculture, 2016). In the year 2017, following are the top ten sea food exporting countries of the world i.e European Union, China, Norway, Vietnam, India, Chile, Thailand, USA, Canada, and Ecuador. European Union with its share of 34.7 billion US dollars occupies a top position among exporting countries of the world. India's share in world sea food exports is 7.6 billion US dollars giving it fifth position in the world exports. In 2017, the top ten fish importing countries of the world were European Union, USA, Japan, China, South Korea, Thailand, Canada, Russia, Australia, and Brazil. European Union with its share of 54.9 billion US dollars occupies a top position among importing countries of the world. It is estimated that by 2050, the world population will reach approximately 9.5 billion and the fishery industry is expected to support food security and nutrition of this growing population (FAO, 2016). Although the usage of fish varies, fishing is an important activity across the globe (FAO, 2000).

1.1.2 An Overview of the Fisheries Sector of India

India with agriculture as the predominant sector of the economy is the seventh largest economy of the world, with the United States of America occupying the first position (FAO, 2018). Having a long coastline of 8118 kms as well as inland water resources, India has a vast potential for marine fisheries with its valuable contribution to the process of economic development. In India, the fishing industry is classified into two major categories, marine and inland fisheries. In addition, the inland fishery is further divided into two major categories that is capture and culture fisheries. Fisheries sector as a sub-sector of the primary sector is a source of livelihood for a large number of economically backward population. During 2017, it provided employment to more than 15 million people registering an increase of 7.14% as compared to the year 2016 (National Fisheries Development Board, 2018). Along with capture fishing, fishermen are involved in allied fishing activities such as marketing, net making, net repairing, curing, processing and peeling. In India there are four maritime states on the east coast, namely, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, and on the west coast the five maritime states, are Gujarat, Maharashtra, Goa, Kerala, Karnataka. Puducherry, Daman and Diu and the two islands of Andaman and Nicobar and Lakshadweep which are the Union territories, are also involved in fishing activities. The glimpse of the fisheries sector of India and Goa are presented in the table 1.1. for the year 2017-18. As on 31st March 2018, total fishing crafts of India were 2,59,993 and Goa had 2725 total fishing crafts,

Table 1.1 Glimpse of the Fisheries Sector of India and Goa

Particulars	India	Goa
Marine fishing villages	3288	39
Fish landing centres	1511	33
Fishing zones	75	Not Available
Fisher folk population	40,56,213	30,225
Fishermen household families	8,74,749	2189
Fishermen families in aquaculture	15,674	Not Available
Traditional fishermen family	5,23,691	2145
Fisheries Co-operative Societies and Associations	57,917	24
Non- Motorized crafts	65,058 (25%)	852 (31.27%)
Motorized crafts	1,22,316 (47%)	1110 (40.73%)
Mechanized vessels	72,559(28%)	763 (28 %)

Note: For Goa Fisheries Co-operative societies includes 17 fishermen associations and 7 fisheries co-operative societies, Figures in parenthesis represents percentage to the total fishing crafts, **Source:** Department of Animal Husbandry and Fishery, Aquaculture, 2017 and Goa Marine Census 2010.

comprising of non-motorized and motorized. During the year 2016, these three sectors in India contributed 3%, 17% and 82%, respectively, to the total landings (CMFRI, 2017). In Goa, in 2017, the mechanized sector (trawlers and purse-seiners) contributed 96%, motorized 3% and 1% to the total fish landings. Tamil Nadu has the highest number of fishing crafts and a highest fisher folk population of 802,912. Goa has the least population of 0.75% of the total fisherfolk population of India (CMFRI, 2018).

The Fisheries sector of India has many stakeholders, the fishermen, government, non-governmental agencies. The Central Government is the facilitator and formulates the policies for marine and inland water resources for the states and union territories of India. As per the Constitution of India, the Central Government has jurisdiction over the fisheries sector in the Exclusive Economic Zone (EEZ) of 200 nautical miles and the State Governments has jurisdiction in territorial waters of 12 nautical miles. Besides this, every state and union territory has a fisheries department which is the main implementation agency for fisheries and aquaculture development programmes. Since Independence, India has witnessed several improvements in the fisheries sector. The Central sector scheme namely, 'Blue Revolution' implemented in 1970 revolutionized the fisheries sector. The massive economic reforms in India in 1991and the associated Liberalization, Privatization and Globalization (popularly known as LPG) has opened up the fisheries sector of India to the world market. Since then, there have been progressive reforms in the fisheries sector of India. India's total fish production (marine and inland) increased from 38,36,000 tonnes in 1990-91 to 1,07,62,000 tonnes in 2016-17. The growth rate of marine fish production was 6.65 % and of inland fish production was 24.07% in 2016-17 with mackerel fish as a major contributor since 1996 (CMFRI, 2017). As on 31st March 2018, the top fish producing states in India were Gujarat followed by Tamil Nadu, Kerala, Karnataka, Maharashtra, West Bengal, Andhra Pradesh, Odisha, Goa and the Union territory of Puducherry (Government of India, 2018). In India, among the nine maritime states and two union territories, Gujarat retained the top position in the marine fish catch for the fifth consecutive year since 2013 with 7.86 lakh tonnes of fish catch followed by Tamil Nadu 6.55 lakh tonnes and Kerala with 5.85 lakh tonnes in 2017. Gujarat recorded highest realization of prices of 17.8% at landing centre and 12.2% at the retail centres in 2017 as compared to 2016. Fish landings increased in all states except Tamil Nadu. In 2017, in India pelagic catch contributed 54%, demersal 26.8%, crustacean 12.6%, and mollusc 6.6% (ICAR, 2018). India's fisheries sector contributed 1.07% to National Gross Domestic Product (NGDP) and 5.15% to the agricultural GDP in 2016 (National Fisheries Development Board, 2018).

India exports 50 different types of fish and fishery products to more than 75 countries of the world. The maritime states in India such as Andhra Pradesh, West Bengal, Gujarat, Kerala, and Tamil Nadu are the key marine states with potential to contribute to marine exports. The marine exports in terms of quantity increased from 1,58,000 tonnes in 1990-91 to 11,34,948 tonnes in 2016-17 and in absolute terms it increased from ₹ 9596.80 crores in 1990-91 to ₹ 37,870.90 crores in 2016-17 (Business line, 2018). There was an increase in quantum of marine exports from India as well as in terms of earnings from foreign exchange. This was due to increase in fish production particularly from aquaculture, technological advancements, economic reforms and trade liberalization.

1.1.3 An Overview of Fisheries Sector of Goa

Goa is one of the smallest states of India with an area of 3702 sq. kms having a coastline of 104 kms. Goa has two districts, namely North and South Goa with 12 talukas, 14 municipal towns, 56 census towns, 334 villages and the literacy rate is 88.70 percent as per population census 2011 (Directorate of Planning, Statistics and Evaluation, 2018). Goa's coastline is about 1.28% of India's coast line. It has numerous bays and headlands facilitating the production of fish on a large scale. Fish is an important constituent of staple food for 90% of Goa's population. The table 1.2 gives a glimpse of geographical features, and profile of fisheries sector of Goa. As presented in the table 1.2, out of the 12 talukas of Goa, seven coastal talukas, namely, Bardez, Tiswadi, Pernem, Salcete, Mormugao, Canacona, and Ponda with their 39 villages are involved in fishing activities. For Goa with its population of 14,59,000 as per the census of 2011, fishing activity is one of the important sources of livelihood for 30,225 of the total population of Goa solely depending on the fishing industry, both marine and inland. As on 2017, Goa is the ninth fish producing states of India.

Table 1.2 Profile of Fisheries Sector of Goa at a Glance

1	a. Coastal length (kms)		104
	b. Continental shelf (up to 100 fathoms depth)		10,000
2	Inland waterways (kms)		250
3	Inland water tanks (hectares)		100
4	a. Marshy khazan lands for shrimp farming (hectares)		4000
	b. Fresh water resources (hectares)		3800
	c. Brackish water areas for fish culture (hectares)		3500
5	Number of coastal fishing talukas		7
6	Number of fishing villages (North Goa)		16
	Number of fishing villages (South Goa)		23
7	Fisheries population up to 2010 (CMFRI Marine Census 2010)		30,225
8	Active population up to 2010 (CMFRI Marine Census 2010)		11,944
9	a. Number of non -motorized crafts registered up to 2017		852
	b. Number of motorized crafts registered up to 2017		1110
	c. Number of mechanized vessels registered up to 2017		763
	d. Number of water sports vessels		2201
10	Number of registered fishing gears (nets) up to 2017		7721
11	a. Marine Fish Landing centers (Major jetties)		5
	b. Inland Fish landing centers		29
	c. Marine Fish landing centers (Medium and Minor)		32
12	a. Fisheries Co-operative Associations (Canoe owners) till 2017		17
	b. Fisheries Co-operative societies (Trawler and Purse-seine owners) till 2017		7
	a. Number of High Speed Diesel outlets operated by Fisheries till 2017		6
13	Annual Fish landing of Goa in 2017		
	a. Marine (Provisional)	120430 (tons)	137540 (Rs in lakhs)
	b. Inland (Provisional)	5332 (tons)	8180 (Rs in lakhs)
14	Exports of Marine Fish Products from Goa in 2017	44,444 (tons)	62,317 (Rs in lakhs)

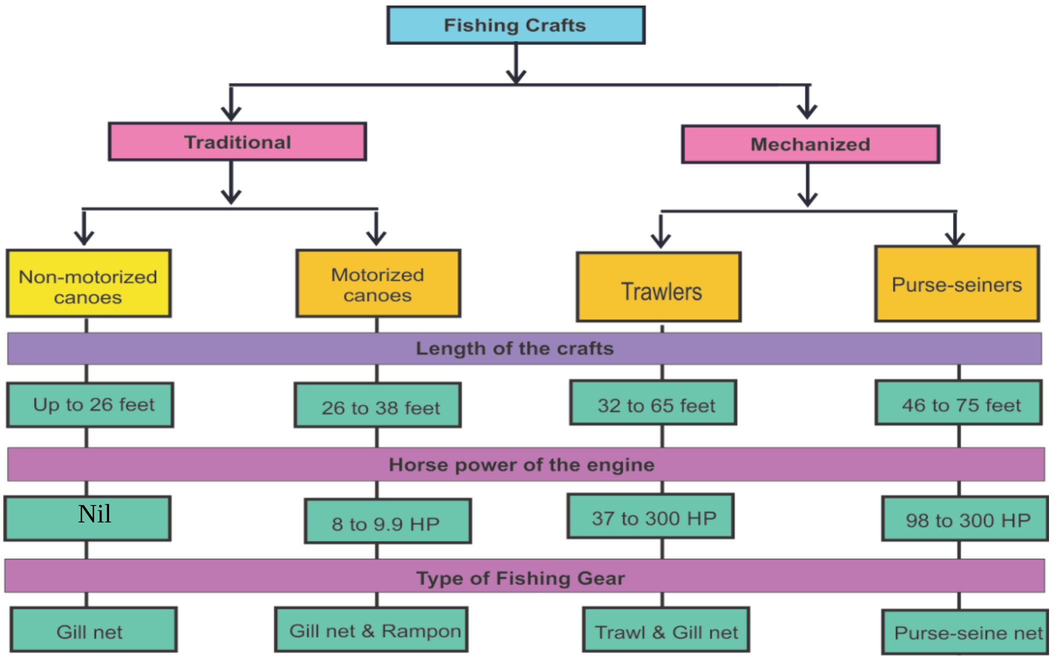
Source: Researchers compilation from data of Fisheries Department, Goa, Goa Marine Census 2010 and MPEDA.

Goa occupies third position in fish consumption in the entire country after Lakshadweep and Kerala (Department of Animal Husbandry, Dairying and Fisheries, 2014). Fish is preferred by rural, urban, high, low and medium income consumers in

Goa leading to a continuous growth in its demand. The fisheries sector of Goa is classified into two sub-sectors, marine fisheries and inland fisheries. Goa has a reasonable scope for fisheries production mainly from marine capture, brackish water, aquaculture, inland culture resources and fish farming. The fish production of Goa is both from the yield of marine capture fisheries and inland. Inland fish production is from the yield of capture fisheries and aquaculture. Inland includes brackish and fresh water. Brackish water includes estuaries, back water and lagoons. Fresh water includes canals, tanks, ponds and reservoirs. Estuarine fishing is a traditional occupation of the Goan fisher folk. Apart from the coastal resources, the State of Goa is blessed with rich network of ever-flowing rivers, fresh water reservoirs, and dams with abundant water. The six rivers, namely; Chapora, Mandovi, Zuari, Talpona, Galgibagh and Sal with their rich nurseries are breeding grounds for the aquatic life, also benefitting the fishermen. Goa is endowed with rich pelagic and demersal fisheries resources (Ansari et al., 1995). There are fresh stock water fish reservoirs in Goa which harvest Indian major carp. Grey mullet, scientifically known as mughal cephalus and locally known as "*Shevto*" was declared as the state fish of Goa in 2016, since its production increased since 2001 till 2017 with an average production of 324 tonnes. In Goa, the fish production species are of pelagic, demersal and molluscs. Mackerels and sardines form 50% of the state production of pelagic species for several years. The other dominant demersal species are squids and cuttle fish and other species. The other important inland fish species are prawns, lady fish, mullets, cat fish, pearl spot and other varieties. In Goa, the most important species is penaeid shrimp popularly known as solar shrimp and is available mostly during the period July to August, which is a very important source of income for the traditional and mechanised sector, but has been overexploited over the years affecting its sustainability (Government of Goa, 2015).

The Government divides the fisheries sector of Goa into two distinct sub-sectors, traditional and mechanised sector. The Fisheries Department of Goa (DOF), the regulatory authority, uses the term traditional in a gear-specific sense, which defines all fishing units, excluding trawlers and purse-seine vessels, as traditional fishing units (MPEDA, 2017). The non-motorized and motorized fishing canoes are classified in the traditional sector and trawling and purse-seine fishing vessels under the mechanized sector. Conventionally, the traditional and mechanised sectors are classified on the basis of gears used for fishing. Popular gears used by traditional artisanal fishermen include "*Rampon*" i.e shore seines, ringseine, gillnets, drift nets, traps, hooks and lines. The traditional fishermen do not use highly capital-intensive technology and do fishing operations in shallow waters on small scale. The mechanized fishing crafts in Goa consists of gillnetters, trawlers, and purse-seiners. The fishermen owning mechanised vessels use capital intensive technology and venture for multi-day and deep sea fishing, upto 12 nautical miles in the territorial waters of Goa to carry out fishing on a large scale. Installation of advanced technological equipment such as GPS, radio telephone, sonar, fish finder, has helped the owners of mechanized vessels to extend their fishing activity to offshore regions. The Fisheries Department since 1963 classified the mechanized vessels on the basis of water cooled marine engines identified as 3, 4, 6 and 8 cylinders. The figure 1.1 explains the classification of the fishing crafts in Goa. The type of canoes used by

Figure 1.1 Classification of Fishing Crafts



Note: Non-motorized canoes (artisanal fishing crafts) do not use horse power engine**, Source:** Researchers compilation from the data of Fisheries Department, Government of Goa and primary survey.

traditional fishermen are "*Rampon*" boats, dugout canoes and out-rigger boats. In Goa, the fishermen use canoes made of wooden and fibre reinforced plastic (FRP). Traditional fishermen with motorized canoes operate in all the seven talukas of Goa and have fishing ramps as landing centres in respective villages. The fishermen owning motorized and non-motorized canoes are under the fishermen associations locally known as "*Goencho Ramponkarancho Ekvott*", (GRE) in the fishing villages of seven talukas and the mechanized vessels are under fisheries co-operative societies situated at respective jetties. In Goa there are district-wise, talukas-wise, and village-wise fish landings. Jetty-wise fish landings are only in the case of mechanized sector. The fishermen with mechanized vessels operate from the five jetties in Goa, namely, Malim, Chapora, Vasco, Cutbona and Talpona (WAPCOS, 2016). The fishing industry in Goa is dependent totally on migrant labour, which mainly comes from states such as Karnataka, Orissa, Jharkhand, Uttar Pradesh, and various other states.

Since Goa is well-connected state with port, airport, railways, national and state highways, it facilitates quick transportation of fish within the state and to other states (Jangam, Subramanian, Wadekar, & Patil, 2018). The state has good potential for marine production and processed fish products for both internal and export markets. There are four major retail fish markets at Vasco, Margao, Mapusa, and Panaji and smaller markets in other talukas of Goa. Goa has only one wholesale market at Margao. Fishermen owning motorized canoes sell their catch to the wholesale, retail markets and agents on a small scale. Fishermen owning mechanized vessels usually sell their catch at wholesale price to all the buyers namely; middlemen fish trade agents, fish vendors, wholesale and retail markets on a large scale. However, in the wholesale and retail markets, agents from Karnataka and other states also sell fish. Fish is sold in the retail fish market without being weighed on random basis locally known as "*Vanto*". An average of approximately 20 trucks loads of fish is sold everyday in Goa's markets. In Goa, the sale of fish in the wholesale and retail fish markets varies approximately between ₹ 1.5 to 2 crores business per day. The main states to which fish is sold from Goa is Kerala, Karnataka, Maharashtra and others. The agents as well as few mechanized vessel owners having processing units export fish and fish products to other countries. Goa imports fish from the western coastal states such as Maharashtra, Karnataka, Kerala, and southern coastal states such as Tamil Nadu, Andhra Pradesh, eastern coastal states such as Odisha, West Bengal and other states for their daily requirements. There are 12 fish exporting units in Goa which depend on 15-20% on local catch and 80% is imported from other states of India. Out of the total marine fish catch in Goa, 20% is for local consumption and 80% is exported. There are eight sea food companies, three fish processing plants, and two boat building yards in Goa. There are six fish meal units in Cuncolim industrial estate.

1.2 Fisheries Industry: A Conceptual Framework

FAO defines "fishing industry as including recreational, subsistence, commercial fishing, harvesting, processing and marketing sectors". The "fisheries industry" refers to capture fisheries, aquaculture and all types of input industry including transport other support services, processing and marketing. The number of people employed directly in the sector as well as the people engaged in the ancillary activities such as processing, net making, ice production, supply of boat construction, maintenance, packaging, marketing and distribution add to the overall contribution of the sector. Besides this, those involved in research and development and administration are also important contributors to the sustainable growth of the fisheries sector (Government of India, 2018). This is a broader definition of the fishing industry. However, in this study, fishing industry and commercial aspects include the contribution of fishing industry to Goa's economy, cost and profit analysis of the traditional motorised canoes, mechanised trawlers and purse-seine fishing crafts. It also includes the role of government in supporting the fishing industry through its various schemes for the welfare of fishermen.

There are three types of fisheries namely; freshwater fisheries, shore fisheries, and deep sea fisheries.

a. *Freshwater*: In fresh water, fish is not caught from waterways but just like agriculture it is domesticated in restricted fields. Fish is caught using traditional tools and equipment (Purkayastha and Gupta 2014). FAO study shows that around two-third of the overall freshwater fish caught in the world is from Southern and Eastern Asia which is raised in flooded fields, rivers, shallow ponds and lakes (Food and Agriculture Organization, 2007).

b. *Shore fisheries*: The shore fisheries are salt water fisheries that are developed on the sea coasts of countries in the continental shelves, (Raj, Monolisha, and Patterson 2017). Shore fishing is performed using trawlers wherein large fishing boats are used with modern fishing tools and equipment to facilitate fishing.

c. *Deep sea fisheries*: The concept of deep-sea fisheries involves fishing in the shallow parts of the oceans which are far off from the coast (Mulimani, 2013). Deep sea fishing means using large fishing vessels which remain in the sea for the entire fishing season, equipped with modern tools and equipment to catch fish in huge quantities, and processing being done inside the vessel itself. It contributes significantly to the fishing industry all over the world.

This study is limited to shore fisheries and deep sea fishing. Despite significant improvements in the fishing industry of Goa there are several concerns that are addressed through the present research and are discussed under section 1.3 of the research problem.

1.3 The Research Problem

Fishing industry of Goa is regarded as one of the important economic activities of the state in the primary sector after agriculture and mining. The share of fishing GSDP was 1.58%, mining 3.18% and agriculture GSDP 3% in 2016-17 (at constant prices with base year 2011-12, at quick estimates). The share of fishing to state GSDP decreased from 2.36% in 1990-91 to 0.93% in 2010-17, while fishing to primary GSDP increased from 16.66% to 21.71% for the same period. In 2016-17, the primary sector composition was 8.40%, secondary sector 57.45% and tertiary sector composition to 34.15% in 2016-17 of the state GSDP at 2011-12 constant prices (Goa, Government of, 2018). The economy of Goa has experienced a manufacturing and service sector led growth over the last few years. The outperformance of the manufacturing and service sector in the state's economy has led to the relative decline in the contribution of the fishing to the GSDP.

The research problem of this study can be described under three sub-headings:

i. What are the trends in fish production (marine and inland), marine exports and contribution of fishing industry of Goa to State's Gross State Domestic Product (GSDP)?

The trends of fish production and marine exports of Goa are important to understand growth and progress of the fishing industry. It provides an insight into the contribution of fisheries sector to primary sector and to the income of the state.

ii. What are the commercial and economic aspects of the motorized canoes and mechanized vessels operating in Goa and its resultant contribution to the fishing industry?

The commercial aspects and the economic performance of motorized canoes and mechanized vessels (trawlers and purse-seiners) are evaluated to assess the viability of the fishing crafts in Goa. The fishermen make huge capital investments, incur high operating and fixed costs on motorized canoes and mechanized fishing vessels in their fishing business. Hence, an assessment of the capital investments, costs, earnings and profits of the fishing crafts is necessary to examine whether fishing business is economically viable for the fishers. In the present study, the profitability of the fishing crafts is estimated by analyzing the capital investments, costs and earnings of the fishing crafts for the year 2016-17. This study will help the fishers to understand whether they can attain profits vis-à-vis high operating costs.

c. What is the role of government in supporting the fishing industry in terms of their welfare schemes and incentives?

It is necessary to examine the extent of government assistance in terms of their schemes and incentives, namely, subsidies, supplies of material, grant-in-aid and contribution from both the Central and the State Government for the benefit of the fishermen. Similarly, it is important to analyze the satisfaction level of fishermen regarding the government schemes availed by them. This helps to understand whether they are content with the fishing business. It is also important to examine the satisfaction level of fishermen owning mechanized vessels regarding the facilities availed by them from fisheries co-operative societies at respective jetties.

1.3.1 Research Questions

Relevant to the research problem, highlighted in the above sub-section, this study addresses the following basic research questions pertaining to the fishing industry in Goa.

What is the trend, growth, share of the fish production (marine and inland) and of the marine exports from Goa to nation, and to the world since liberalization i.e. 1990-2017? What is the contribution of the fishing industry to Goa's state income and to the primary sector? Does the size and categories of the fishing crafts determine the variation in the capital investments, costs, earnings and profits of the motorized canoes (26-38feet) and mechanized vessels (32-75 feet) (small, medium and large) in Goa? Whether the selected socio-economic characteristics of the fishermen i.e. the independent variables in terms of gender, qualification, caste, experience of fishermen, size of the family, number of family members in fishing, financial status and the geographical position (whether living and operating crafts in North or South Goa) of the fishermen have any impact on the dependent variables, net profit, earnings and savings from fishing business? What is the impact of the selected input of factors of production on the output of fish catch i.e. earnings from fishing business? What role does the government play in terms of disbursements of schemes and incentives to support the fishing business as well as the sustainable growth of the fishing industry? What is the compounded annual growth rate and per capita benefit of various schemes? Are the fishermen satisfied with these schemes and their fishing business? Are the fishermen owning mechanized vessels satisfied with the facilities provided by the fisheries co-operative societies at the respective jetties? What are the problems faced by the fishermen owning motorized canoes and mechanized vessels in fishing business in Goa?

1.4 Significance of the Study

Till 1950 fishing in Goa was predominantly carried out by traditional fishermen with non-motorized dugout and wooden hull canoes. The process of mechanization of fishing business commenced in 1958, but it was after liberation that the fisheries sector underwent revolutionizing and technological changes. Goa has witnessed the evolution of mechanized fishing in the form of trawling and purse-seining from traditional motorized and non-motorized fishing. Today, the traditional and the mechanized sector play an important role in the economy of Goa through fish production (marine and inland), export, and employment. Fish production in Goa is exclusively from the marine and inland capture fisheries, though aquaculture contributes in a limited way to the production. From 1990 to 2017, the average production of marine fish was 96% and 4% from the inland sector which highlights the predominance of the marine fisheries.

The Central and State Governments are supporting fishing business in several ways. They provide financial assistance to the fishermen, amend the regimes, and legislations to sustain the industry and provide infrastructural developments; so that the fisheries sector in the state will eventually contribute to the state's and nations economy. The State Government through its policy decisions increased size of the fishing crafts since 1960-70 to 2016-17 in response to the demands of the fishermen. The size of the motorized fishing crafts which were below 26 feet has been increased from 26 feet to 38 feet in 2014-15. The size of mechanized fishing crafts which was 42 feet in 1980-90 increased up to 75 feet in 2015-16. The number of traditional country crafts which were 4125 in 1960-61 decreased to 2060 in 2016-17. However, the number of mechanized vessels (trawlers and purse seine vessels) increased from 4 in 1960-61 to 763 in 2016-17. The study by (Gaonkar, Rodrigues, & Patil, 2008) finds that in 2008 there were 1035 mechanized vessels using 30-120 horsepower engines operating in Goan waters using trawl or purse-seine nets. There was motorization of canoes and mechanization of fishing vessels due to the subsidy provided by the government to the fishermen. These measures by the State Governments have helped in the growth and development of the fishing industry.

The marine production in Goa has increased after mechanization due to an increase in number of mechanized vessels including trawlers and purse-seiners as well as motorization of canoes. An increase in marine fish production from 1960-61 to 2016-17 in the State of Goa, can also be attributed to development of infrastructure facilities and financial assistance in the form of schemes by the government to support fishing industry. It is also due to technological developments in fisheries sector which are adopted by the fishermen in the traditional and mechanized sector. This is evident from the fact that in Goa marine production which was 17000 tonnes during the period 1960-61 increased to 24,600 tons in 1965 and subsequently increased to 1,20,430 tons (provisional) in 2017 (Goa, Government of, 2018). During the year 2015-16, the mechanized sector of Goa contributed 89%, motorized sector 8% and non-motorized sector 3% in terms of fish production (CMFRI, 2016). During the year 2016, contribution by pelagic resources was about 90%, demersal 6.5%, crustacean and molluscs resources 2.4% and 1.2%, respectively, of the total landings (Central Marine Fisheries Research Institute, 2018). Marine exports of Goa increased from 4289 metric tons in 1991 to 38209 metric tons in 2016 (MPEDA , 2016). The exchange value of marine exports from Goa has increased from ₹ 821 lakhs in 1990-91 to ₹ 58,271 lakhs in 2016-17 (MPEDA, 1991) and (MPEDA, 2017). Goa's marine exports were 50,571 tonnes with foreign exchange earnings of ₹ 711.9 crores in 2017-18 (Goa, Government of, 2018). The exports from Goa are mainly of shrimps, ribbon fish, scuttle fish, tuna, squids and other species. The major countries that Goa exports its marine fish and fish products mainly through Mormugao Port are South East Asia, China, Japan, USA, UAE, European Union and others. From 1991 to 2017 highest marine exports from Goa were to the countries of South East Asia, followed by China. The expansion of marine exports of Goa to a large extent follows the national pattern.

This study will be useful to fishermen, Government and other stakeholders in various ways:

a. It will help fishermen to make sound investment decisions, in the light of capital investments, operating and fixed costs incurred on their fishing crafts.

b. Fishermen will benefit if they are aware of the inputs of factors of production which will help them to improve their fish catch from fishing crafts resulting in an increase in fish production and earnings.

c. The knowledge of inputs of factors of production which help the fishermen to increase fish catch also helps the policy makers to formulate policies benefiting the fishing community.

d. It will help the government to understand inadequacies of the schemes, infrastructural facilities and revise the same for sustainable growth and development of fishing industry.

e. It will help the government to understand the problems of the traditional as well as mechanized sector of marine fishery, so as to implement developmental plans for betterment of the fishing community.

f. It will also help the fisheries co-operative societies to understand their inadequacies and rectify the same through government intervention.

1.5 Objectives of the Study

Since the aim of the study is to analyze commercial aspects of the fishing industry to Goa's economy and assess the contribution of the fishing industry to the primary sector and to the state's income, this study has formulated the following research objectives:

1. To analyze the trends in marine and inland fish production, marine exports and their contribution to Goa's Gross State Domestic Product.

2. To examine the variation in capital investments, costs, earnings and profits of the fishermen owning the different categories of traditional motorized canoes and mechanized vessels, both trawlers and purse-seiners**.**

3. To study the role of Government, with respect to financial assistance in the form of schemes provided to the owners of traditional motorized canoes as well as the mechanized vessels in Goa.

The focus of this study is on contribution of fishing industry of Goa to the State's economy. It also focusses on the commercial and economic aspects of motorized canoes and mechanized fishing vessels (trawlers and purse-seines) owned by the fishermen in Goa. Further, this study analyses the role of Government to support and promote the fishing industry through various schemes for welfare of fishermen in Goa. This study has attempted to show the determinants influencing the fishing income generated by fishermen in Goa for their livelihood. This research is empirical in nature, and an attempt is made in the present study to take a holistic view of Goa's fishing industry which is the smallest but a well-developed state of India.

1.6 Data and Research Methodology

This study uses both primary as well as secondary data. The sub-period average percentage, trends, CAGR, Coppock Instability Index and Coefficient of Variation are analyzed by using the variables, namely; marine and inland fish production, marine exports, at the global, national and Goa level using time series secondary data from 1990-2017. The sub-period average percentage analysis, trends, CAGR and Semi-log regression model is computed for the variables, namely; share of GSDP of primary sector to Goa's GSDP, share of fisheries sector to the GSDP of Goa, and marine species-wise fish production from 1990 to 2017. The sub-period average percentage and CAGR is analyzed for the variables jetty-wise marine fish catch in Goa from 1998 to 2016. The marine exports from Goa to different destinations of the world are analyzed using ranking method and CAGR semi regression model from 1995 to 2017.

The study makes use of primary data obtained through interview schedule of 291 fishermen owning motorized canoes and mechanized vessels for the fishing season from August 2016-May 2017. The statistical tools namely, Independent sample *t* test, one way ANOVA, Kruskall Wallis test, Man Whitney test and Friedman's test are used in the study. The economic performance of marine fishing methods (gill net, trawling and purse-seine fishing) used by motorized and mechanized fishing crafts is assessed through the economic indicators to measure the input-output (cost ratios) efficiency, capital productivity, labour productivity, profitability ratio, and marginal efficiency. Ratio analysis is used for the purpose of comparison of the economic indicators of different size fishing crafts (motorized canoes and mechanized fishing vessels). The Cobb Douglas production function theory with the help of log-log model form of multiple regression is used to study the impact of input of factors of production on the output i.e. earnings from fish catch of motorized canoes and mechanized fishing vessels. The multiple regression model is also used to study the impact of socio-economic characteristics of the fishermen on the net profit, earnings and savings from fishing business. Percentage analysis and CAGR method is used to measure growth of the government schemes for the period 1990-2017 using the secondary data obtained from the Demand Book, Government of Goa. The satisfaction level of the fishermen on the likert scale regarding the government schemes availed and the social and economic factors affecting their fishing business are analyzed using mean ranking, Fishers test and Independent sample *t* test. The chapter three on research methodology explains in detail the theoretical base, data and data sources, sampling design, hypotheses, variables, statistical and econometric tools used in the present study.

1.7 Chapterisation Scheme

The entire research study is organized into nine chapters, bibliography, and appendices. A brief outline of the chapterisation of the study is presented as under:

Chapter 1 is the introductory chapter which highlights the background of the study, states the research problem, significance of the study, research objectives, data sources and methodology, scope and limitations of the study.

Chapter 2 presents a review of literature on fishing industry. It examines the research done highlighting the significance of the fishing industry within India and across different countries. It also presents the research gap of the study.

Chapter 3 describes in detail the research methodology adopted in the study. It begins with operational definitions, related theoretical base, data and data sources, sampling design, hypotheses and variables used in the present study. This is followed by explaining the related statistical tools, econometric models, and techniques used in the present study. In the final section, it describes the socio-economic characteristics of the respondents.

Chapter 4 titled "Contribution of Fishing Industry to Goa's Economy" examines the trends in fish production and marine exports of the World, India and Goa. It also analyses the share of the fishing industry in Goa's economy. It examines the share of Goa's fish production (marine and inland), marine exports to the country and to the World. This is followed by using the Coppock Instability Index and Coefficient of Variation for fish production and marine exports of World, country and Goa.

Chapter 5 entitled "An Analysis of Cost, Earnings and Profit of Motorized Canoes of Fishing Business in Goa", examines the variation in the capital investments, costs, earnings and profits of motorized canoes used for the fishing business in Goa.

Chapter 6 titled "An Analysis of Cost, Earnings and Profit of Trawlers of Fishing Business in Goa", analyses the variation in capital investments, costs, earnings and profits of trawlers used for the fishing business in Goa.

Chapter 7 entitled "An Analysis of Cost, Earnings and Profit of Purse-seine Vessels of Fishing Business in Goa", analyses the variation in capital investments, costs, earnings and profits of purse-seine vessels used for the fishing business in Goa.

Chapter 8 titled "Role of Government in Promotion of the Fishing Business in Goa, examines the trends and CAGR of various schemes provided by the government for welfare of the fishermen. It analyses satisfaction level of the fishermen in relation to the schemes; and assesses the problems faced by them in their fishing business.

Chapter 9 is the concluding chapter titled "Findings, Suggestions and Conclusions". This chapter provides a summary by presenting the findings, policy suggestions, conclusions, contribution of the study and scope for future research.

1.8 Scope and Limitations of the Study

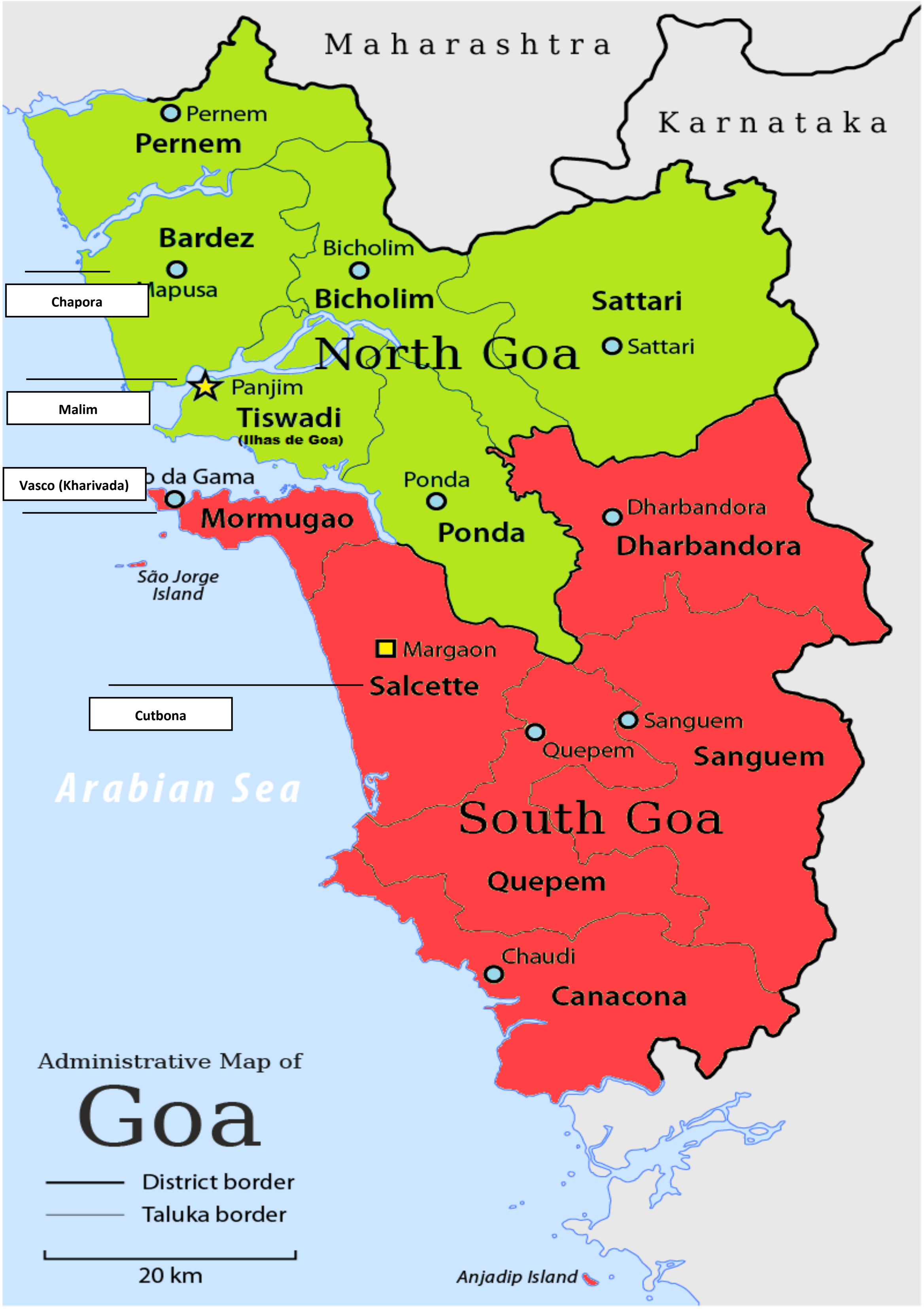
This study is confined only to the state of Goa. The present study relies on different data sources and periods. For the major part of this study, primary cross sectional data was generated by interviewing the fishermen owning motorized canoes, and mechanized (trawlers and purse-seine) vessels in Goa. The traditional motorized canoes taken for the study are grouped as (26-30 feet and 31-38 feet in terms of size), and of mechanized vessels both trawlers (small -32 to38 feet, medium 39-45 feet, and 46-60 feet in terms of size), and purse-seiners (medium 46-60 feet, and large 60-75 feet in terms of size).

In case of supplementary analysis, the secondary time series data were assembled by taking aggregate data set for 1990-2017 of Goa's fishing industry. Chapter four uses secondary sources of data for marine, inland fish production, and marine exports from 1990 to 2017. Chapter's five to seven make use of solely primary data to study the variation in capital investments, cost, earnings and profits of motorized canoes, trawlers and purse-seine vessels in Goa. Chapter eight highlights the role of government through schemes to develop the fishing industry, but the data on the number of beneficiaries who availed of the various schemes were available with the Fisheries Department, only for the years 2012-2018. However, the data on government schemes given by both the Central and State Government to the fishermen were available only for the period 1990 to 2018.

There were some difficulties faced by the researcher in the collection of secondary data. Although, Goa's fishing sector has a long history, the data of imports of marine fish in Goa and the labourers employed in the fishing industry are not available with the Goa Government as there is no mechanism available to collect the same with the government till date. Also, the Fisheries Department, Government of Goa does not have these records. The jetty-wise marine fish catch data in quantity were available with the Fisheries Department only for the period 1998-2017, but were not available for the period from 1990 to 1997. Similarly, marine exports data from Goa to different countries of the world were available with MPEDA only from 1995 to 2017. Species-wise marine exports data of Goa were not available from 1990 to 2017; hence they are not considered for the analysis. Non-availability of the secondary data restricted the analysis in the study. This study does not include fishermen owning non-motorized canoes engaged in fishing business. Further, non-operational motorized canoes and mechanized vessels are not considered for the study. Also, the aquaculture sector, fish trade agents, fish processing units, exporters, vendors involved in sale of fish, and fish meal industries do not come under the scope of this study.

Figure 1.2 explains the map of Goa showing major fishing jetties. The next chapter two will give an overview of the review of literature of fisheries and highlight the research gap.

Figure: 1.2 Map of Goa Showing Major Fishing Jetties



Chapter 2

Review of Literature

Chapter 2

Review of Literature

2.1 Introduction

This chapter includes the review of literature and related models used in the present study. The review of literature is carried out by making use of secondary data sought through books, scholarly research works, academic journals and various government publications; in libraries as well as online material was accessed pertaining to the area of research. A comprehensive review of the previous research work done by other scholars helped the researcher to develop the research objectives of the study, hypotheses and identify the new research problem. It further helped the researcher to identify the statistical tools which are used for data analysis. The empirical evidence, types of techniques, models used by other researchers is used to identify the research gaps so as to decide upon the technique, data and resource requirements for this study.

This chapter presents a review of literature on the commercial aspects of the fishing industry. This is done as per the objectives of the study and is organised into foreign and Indian literature; the data sought is then further arranged into four sections so as to categorize them according to relevance of the present study. Section 2.2 highlights the review of literature on the history of fishing industry, theories of fishing industry and methods of fishing. Section 2.3 reviews the research on marine and inland fish production and marine exports. Section 2.4 throws light on the economic and commercial aspects of the traditional and mechanised fishing sector. Section 2.5 presents the review of socio-economic factors affecting the fishermen in fishing business. Section 2.6 reviews the research on the role of government towards the fisheries sector. Section 2.7 focuses on the problems faced by the fishermen in fishing business; while section 2.8 explains the research gap in the existing literature.

2.2. A Brief Review of the History of the Fishing Industry

Since times immemorial fish has been considered as an important food resource. In the olden times fishing was considered as a form of wealth. In general, fishing activity has its own historical background and in particular from the economic point of view fishing is a source of income to the fishermen living in the coastal areas. In the history of human civilization, both fisheries and agricultural farming expanded simultaneously. The hunting of fish was common in the prehistoric times. In the late Old Stone Age (40,000 BC), shellfish and sea fish were found near a river or lake of cave dwellers. The salting of fish started during the Bronze Age (3500 BC). The ancient civilizations of Egypt, Mesopotamia and Indus Valley traded dried fish. Fish was as an important food for both the rich and poor people among the Greeks and Romans. In ancient Greece, during the Iron Age, people had great trades in dried, smoked and salted fish. During the Roman Empire, the period from 400 BC to 450 AD there was emergence of highly organized fisheries. In the Atlantic, fishing activities were more pronounced, and herring and similar other fisheries gained importance in the Middle Ages (500AD to 1500AD). In England, ice preservation of fish started in 1786 (Whittle, 2011). Later in the 18th century, Chinese were the first to use ice to preserve fish in the process of transportation. In the 3rd century BC, Chanakya was the first statesman to frame the laws for fish management and conservation (Government of India, 2006).

Traditional methods and skills were applied earlier by men for fishing (Tidwell & Allan, 2001). The application of science to fishing industry started during the 19th century. However, up to 19th century, the universal mode of fishing was practiced with the help of fishing craft propelled by wind, sail and muscle power. Keynes (2006) also focused on the modernization of fishing. Today, the traditional methods of fishing have been replaced by modern methods and have adopted increasing mechanization. Both, related to various aspects of marine fishing and aquaculture activities have preceded the mechanization adopted in marine fishing and traditional methods (Ugoala, 2014). The advanced technologies and high-level of mechanization adopted by advanced countries has helped to improve their fishing productivity (Pingali, 2007). The deep sea fishing, off-shore fishing, and fish culture had great scope for the fisheries sector (Nayak, 2007b). Making use of lights was adapted by man since historic times, as fish species are attracted towards light. In India, more than 200 year old Chinese dipnets were used in Kerala. In earlier times kerosene lamps were used, but now compact fluorescent lamp (CFL) lamps are used. Japan is one of the major nations which practices light fishing, followed by Korea, Malaysia, Vietnam, Thailand and Philippines. Purse-seining with light was also practiced in North Sea, Mediterranean Sea, France, and Turkey. The above reviews throw light on the history and the mechanization of the fishing industry.

In the past fishing was preferred as providing nutritional food rather than business and employment. However, Malthus (1798) argues that fish was referred as the vital source of food and fishing was one of the major source of providing employment to the community. As per the industrial classification system, fisheries come under the agricultural sector, though processing of fish is done in the industrial sector. Marshall (1974) and Smith (1937) stated that “Fisheries require both fixed and circulating capital to cultivate them and their produce results in profit”. The resources from the sea are replenishable and renewable compared to agricultural resources. In case the quantity of fish is reduced in the sea, in the next year itself it will be renewed and stock is maintained constant throughout the year without affecting its harvest. Pigou (1932) found that during the fish breeding season, fishing operations are banned in the mechanized sector which helps to increase the fish stock. However, Viner (1937) argues that free use of natural resource will tend to exploit the particular resource. Further, Ralph (1964) opines that the absence of regulations in fisheries leads to non-optimum utilization of fish resources. Later, Turvey (1964) claims that for sustainable production of fish, regulating and storing the resources of fish are duly important.

The next section discusses the theories related to the fishing industry.

2.2.1 Economic Theories Relating to the Fishing Industry

The following theories are important for the prospects of the fishing industry.

i. Biological Theory of Fisheries Management: The biological theory of fisheries management assumes that when population increases there is corresponding increase in fishing effort. This creates pressure on the existing fish stock. Thus, when the stock of fish reduces, it is essential to control the fishing effort. In another theory, an American biologist Milner B. Schaefer, in 1954, discovered the association between the sustainable yield, population and fishing effort. In this theory it is assumed that fish stock depends on factors such as weight, growth and mortality. Furthermore, Korakandy (1996) also added that fish catch depends on the population and fishing effort. The model developed by Schaefer (1991) acts as a bio-economic model which relates the economic production model to biological model for the growth of fishery, and it is a simple technique to assess the fish stock. Another model developed by Gordon (1954), based on Schaefer's model, states that maximum economic yield in the long run would lead to economically sustainable revenue. According to Gordon, the total revenue is a function of the fishing efforts and fishery input and output values are expressed in terms of total cost, which in turn is equivalent to the total variable and total fixed cost. The total operational cost consists of cost of fuel, labour wages and food. The fixed cost consists of expenditure to be incurred before making any direct fishing effort. Thus, the cost per unit of fishing effort is constant. This model states that the yield will be in equilibrium, only when total revenue is equal to the total cost. The above theories explain the impact of fishing effort on fish production, cost of fishing and the sustainable yield. However, the next theory on effect of free trade on fisheries highlights the influence of free trade on food security and various stakeholders of the fishing industry.

ii. The Effect of Free Trade on Fisheries: This theory explained effect of international trade on the countries which import and export fish stock, and its effect on producers, consumers, and on the entire society at large. It explains how price is assigned in the market, its impact on income of all investors and how a country can benefit from trade with other countries. A study by Gudmundsson et al., (2006) signifies the efficient supply of seafood, its prices and the marketing system simplifying trade.

iii. The Economics of Subsidies: The theory of economics of subsidies helps to understand two questions namely; the subsidies given by the government and its impact on international trade. Subsidies help the benefeciaries in other countries to benefit from lower world prices, but producers in foreign countries would be the net losers and have to compete with lower prices. Those producers who cannot compete have to exit the industry. However, in a native country the benefit of the consumers would be offset with the loss of the producers (World Trade Organization, 2006).

The next section discusses the methods used by fishermen for fishing in the traditional and mechanized sector.

2.2.2 Methods of Fishing used by Fishermen

Fishermen would need a boat and fishing gear (nets) as basic essentials for fishing. Fishermen use both passive and active gears as per their need. Passive gears are used when the fishermen wait for the fish to get entangled in the net, and active gears are used when the fishermen need to chase, disturb or circle shoals of fish. The fishermen use multiple fishing gears for marine fishing in the coasts and deep seas namely; operation of beach seines, gill net fishing in off shore waters, cast net fishing in shallow waters, seasonal hook and line fishing, trawling and purse-seining for deep sea fishing. The methods of fishing are explained as follows:

(i) Operations at Beach Seines: A beach seine locally known as "*Rampon*" was introduced in the 19th century for fishing. It requires on an average about 25 to 30 fishermen or even more depending on the size of the fishing net (Paul, 2014).

(ii) Gill Net Fishing: This method of fishing is done in deep waters at a distance of seven to eight miles away from the shore. These nets have a larger mesh size to catch fish, such as shark, seer fish, pomfrets, skipjack, and other species. This type of fishing is done in all fishing seasons (FAO, 2018).

(iii) Cast Net Fishing: This is used widely across India and it is a primitive type of gear carried out in shallow waters with a boat and a net (Floyd, 1965).

(iv) Fishing by Hook and Line: This method of fishing is done only in peak fishing season to particularly catch seer fish, silver bar, skip jacks, serranus and char menus (Green Space, 2008).

(v) Trawling: The trawl net has a large bell-shaped net and a big mouth that tapers through the body to the cod end. This method uses an active gear as the mechanized boat pulls a trawl net, called the trawler, and therefore the name trawling. Trawling can be done in various ways. One method is when the net skims just below the water surface or in the mid-water, it is called mid-water trawling, while another method is bottom-dwelling, where species of fish such as crustaceans, prawns are dragged by the net known as bottom trawling. In bottom trawling, an iron chain called a 'tickler' is used to catch fish at the bottom part of the mouth of the trawl net. This hollows out the prawns and other bottom-dwelling fish from the surroundings (Suuronen, 2005).

(vi) Purse-seining: This active fishing method uses a huge encircling purse-seine net of small mesh size to catch tonnes of pelagic shoals of fish such as mackerels and sardines and tiny baby fish. All the purse-seine vessels use a dinghy (small boat) tied to the purse-seine vessel. A study by Pravin & Meenakumari (2016) shows that purse-seining method is also used in Goa for fishing which needs more labour on board.

The next section 2.3 reviews the studies related to fish production and marine exports.

2.3 Studies Related to Fish Production and Marine Exports

The following review of literature includes the studies on marine and inland fish production as well as marine exports.

2.3.1 Studies Related to Marine and Inland Fish Production

The fisheries sector contributes to food security, global business and employment generation. During the post-WTO period, India's marine production has grown phenomenally. Mohsin et al., (2015) for instance studies the contribution of fish production and trade to the economy of Pakistan by examining the trends in fish products, marine exports and imports from 1991 to 2010. The study finds that fish production of dried, salted or smoked fish and frozen fish excluding fish fillets and meat exports increased in Pakistan but the country had to import frozen fish due to the increasing demand. Salim & Antony (2015) examines 100 fish markets in coastal Kerala in 2013-14, and finds that marine fish landings showed a positive growth of 10% in the landing centre and 20% in the retail sector. Their study concludes that the share of the fishermen's profit depends on the commercial value of species of fish, seasonal landings, and demand in the retail market. In another study by Salim & Antony (2015) in India, finds that there were 1.35 lakh mechanized and motorized crafts, and one lakh non-motorized crafts carrying out fishing activities in India. The mechanized sector contributed 68%, motorized 25%, and the non-motorised 7%. In the past 50 years, fisheries department has developed for about 6 times with total landings assessment of about 3.78 million tonnes in 2013-14.

Nedumaran (2014) examined the marine sector development and growth of fishing industry in India and found that fisheries and aquaculture are the most important sectors for food production which provides food security, nutrition, contribute to agricultural exports and employment to a large number of people in India. The fishing sector in India also stimulates other subsidiary industries and generates foreign exchange through marine exports. Thakur (2014) also found that fishing industry in India is a significant earner of foreign exchange. In order to satisfy an increasing demand of fish in the country and also to increase marine exports, the author suggests that government has to provide infrastructure facilities in the form of increase in the number of fishing harbours and fish landing centres in the country. Goswami & Zade (2015), made a comparative statistical analysis of fish production in India during the period 2013-14 and the actual growth rate of fish production in the previous years. They found that since India has vast inland and marine resources it helps in the immense growth of fisheries sector which contributed to ₹ 30,213 crores during 2012-13. They also found that India was a major producer of fish through aquaculture and ranked second in the world after China in 2013-14 and the fish catch reached 9.5 million tonnes contributing to 5.68% of global fish production.

A study by Subramanian & Komarpant (2003) shows that per capita fish consumption in Goa is 7.4 kg as against the national average of 5 kg, however, they claim that the recommended average is 11 kg. Morkar (2014) analyzed growth of fishing industry, problems and prospects of fishing activities of Goa and concluded that the share of fishery sector in Gross State Domestic Product (GSDP) of agriculture and allied sector was 1.23% in 2011-12. The author found that during 2012, marine fish production was 86,628 tonnes and inland fish production 3,887 tonnes, out of which 40,000 tonnes were exported earning a foreign exchange of ₹ 36,844 lakhs.

Katiha et al., (2005) provided an overview of the inland aquaculture in India. The authors found that in India, inland aquaculture business had developed faster than the marine capture fisheries. However, aquaculture was limited to the inland sector mainly from carp production. During the past 15 years, there was enormous growth in aquaculture in the inland sector and the benefit cost ratios for different systems of aquaculture varied from 1.22 to 1.86. The return on capital investment was much higher than return to labour due to low labour input. The aquaculturists benefitted due to the use of semi-intensive aquaculture processes. They suggest the need to use quality fish seed and feed for aquaculture production to increase the efficiency by more than 50%.

Kurup et al.,(1987) made a comparative analysis of marine fisheries of the two states, namely, Karnataka and Goa during the period 1975-84 and found that marine fishery in Goa had many features in common with the state of Karnataka. The species such as oil sardine and mackerels were the main species in marine fish landings in Goa. In both the states there was an improvement in the landings of the pelagic and demersal resources during 1975-84. However, they reported that depletion of fish catch would seriously impact the future prospects of the fishing industry. Mohamed, Muthiah, Zacharia, & Sukumaran (1998) analysed the main fishing gears used, main species of fish production, developments, and fisheries management in the coastal state of Karnataka. They observed that in 1950's marine fish production in the state was only 57,000 tons per year which increased to 2,50,000 in 1989, however, by 1995 it declined to 1,50,000 tonnes per year. The authors found that the important species of fish were overfished and an increase in fish catch was due to the major change in fishing gears during the period 1980-84 and 1990-95. They suggest the need to reduce the fishing effort in order to reduce overexploitation.

The capture fisheries production and its economic role in Pakistan was examined by Mohsin *et al.,* (2017) and found that the capture fisheries production is decreasing over the years. The main reasons were overexploitation of fishery resources, which has resulted in ecosystem damage leading to decrease in biomass production. Further, a study by Ansari, Achuthankutty, & Dalai (2006) examined the overexploitation of fishery resources of Goa and found that fish catch has exceeded the maximum sustainable yield, resulting in negative growth in the subsequent years. The study showed that fish production in Goa significantly increased from 17000 tonnes in 1963 to a maximum of 1,02,922 tonnes in 1993 as a result of mechanization. They suggest that the government should review on long-term basis the policy decisions on sustainable fisheries development.

2.3.2 Studies on Marine Exports

Exports are important for the country to earn foreign exchange as well as for growth of the economy. Globally, the fisheries sector witnessed incredible growth in the entire food industry with productive trading in both supply and demand. FAO (2006) study in 11 countries on responsible fish trade and food security put forth the argument that although international trade in fish products had a positive impact on food security, it had a negative impact on fish resources in the developing countries involved in trade. The study suggests the need to implement efficient and sustainable resource management practices in these countries for success in international trade. M. B. Hossain (2006) evaluated the performance of marine exports of fisheries sector in Bangladesh by identifying its strengths and weaknesses. The study suggests that policy incentives can play a significant role to increase fish exports but there is need to introduce quality assurance systems based on HACCP (Hazard Analysis and

Critical Control Points) to comply with the sanitary, phytosanitary and technical barriers to trade measures in order to boost marine exports.

A. Kumar, Joshi, & Badruddin (2002) provided an overview of the changes in composition of seafood exports and the factors which determine exports from India. They analysed comparative advantage of fishery products in the international markets and recent trade policy changes in the fisheries sector. They used time series data from 1980-81 to 2000-01, in the log-linear form using the Ordinary Least Squares (OLS) method to study the growth in exports of fishery products. They found that liberalization policies of Government of India helped to develop India's marine exports. They recommended that in order to increase India's marine exports, it is important to adopt different sanitary, phytosanitary measures and international hygiene standards consistent with WTO guidelines. The Marine Products Export Development Authority (MPEDA), annual report 2002 documented that in India substantial amount of export earnings is from capture shrimps, but it is only between 50,000-55,000 tonnes in spite of the increase in the fishing efforts. The reports conclude that the only way to enhance export earnings was to culture shrimps in India. However, in another report of MPEDA of 2007 it was highlighted that India had a vision to become the top sea food exporting country in the world in terms of quantity and value and maintain a share of 5-6% in the world exports. Since fish trade is important for food security in India, the study suggests that India should adopt total quality management from fish catch to exports and the landing centers need to be made of international standards. The report concludes that India estimates to increase employment in the sea food industry from 3 million in 2007 to 6 million in 2017 (MPEDA, Ministry of Commerce and Industry, 2007).

Sajitha (2016) analyzed the export performance of marine product exports from India from 1989 to 2011 using secondary time series data. This study found that marine fishery sector is a major foreign exchange earner in the Indian economy and seafood export from India is an important component of its total agricultural exports. The author suggests that Governmental support is a requisite to ensure development of marine fish markets in India to improve its position in the world market. A study by Harish & Natarajaiyer (2016) examined India's export achievements of marine products, port-wise, market wise and item-wise to different countries of the world. They studied the contribution of cultured shrimp, scampi and item-wise exports of crabs from India using secondary data from 2010-15 using econometric tool of correlation and regression. The results showed that India's seafood exports in 2015 reached a high value of US$ 5.02 billion and India occupied a second place as the largest fish producing nation in the world. They suggest that the vast resources of India can be utilized successfully to uplift India's marine product export trade in the international market.

Navghan & Ranjan Kumar (2017) analyzed the competitiveness of seafood trade of India, its efficiency and relative trade advantage in the Indian market from 2001-2014. Their findings reveal that India has a comparative advantage in export of fish and fish products since the export competitiveness index (XCI)>1. The top four export destinations for sea food products of India are South East Asia, USA, and European Union. In India, there were increasing exports for sea food products and reduced imports due to which it has a positive trade advantage. The study suggests that India can achieve further progressive export growth if it incorporates the fluctuations of price and exchange rate of the international market. A study by Raghuram & Asopa (2008) highlight the issues with regards to infrastructure facilities for production and export of marine products from India. Their study found that in the international market there is great demand for India's marine exports especially for value added marine products such as ready to eat cooked products and freeze dried shrimps. However, India's marine fishing industry uses low quality infrastructure in pre-processing as compared to post-processing stages. This study suggests that there is a need to improve the infrastructure for processing equipment during pre-processing stage as well as the supply chain in India's fishing industry in order to increase sea food exports. Further, in another study, the trade barriers, prospects, challenges of sea food industry in India with regard to marine exports were analyzed by (Rajamohan & Jebadurai, 2014). It was found that exports of India are controlled with various activities such as over-fishing, environmentally harmful fishing practices, trade in endangered species and trade barriers. However, the exporters manage these challenges with the help of various trade organizations like General Agreement on Tariff and Trade and World trade organization and others.

The studies on the trends of marine product exports in India by Anjana & Rosada (2015) for the year 2013-14 was analysed using Compound Annual Growth Rate Method (CAGR) method to measure growth of marine exports. Their study showed that India's share to marine exports increased to 5.98% in terms of quantity in tons. Among the main exported marine products, frozen fish occupied the first position followed by frozen shrimps in terms of quantity in tonnes. Saravanan (2015) explored the export and production performance of India's fishing industry during the period 2000-01 to 2010-11. The results show that there has been an increase in the values in production from 205.90 thousand tons to 340.57 thousand tons from 2000-01 to 2010-11. Among other marine states, Karnataka ranked highest in marine fish production while Andhra Pradesh ranked highest in the inland fish production. Further, the entire nation witnessed an upward trend in marine production. In another study by (Government of India (2017), it was found that there was an upward trend in marine production in India, due to the various developments such as 'Digital India' and 'Skill India' that promoted exports and imports in the country.

2.3.2.1 Studies on Coppock Instability on Fish Production and Exports

Wasim (2007) made a comparative analysis on the issues, growth and instability of inland fish production in Sindh (Pakistan) a spatial-temporal analysis, to examine the progress and variability in inland fish production for two periods, period I (1975-1988) and period II, (1989-2002). The author used linear, exponential, and semi exponential functions to examine the period-wise and whole period trend of inland fish production. The results showed that in period II, the growth rate of inland fish production of Khairpur, Larkana, Hyderabad, Badin, Thatta and of Sindh province improved, but in the case of Sanghar and Tharparkar districts, it reduced. During period I, majority of the districts had reasonable development with less uncertainty in inland fish production as compared to period II.

Shyam et al., (2004) conducted a study on the effectiveness of Indian marine products in a liberalised trade economy. They explored the impact of WTO agreements on the Indian fisheries sector using time series secondary data from April 2002 to August 2003. They observed that there was a higher degree of instability in fish exports in the post-liberalisation period. The authors found that revenue generation depends on the quantity and value of marine exports. They conclude that there is a need for India's fisheries exports to be dynamic with respect to the global fisheries exports. A study by Dash & Patra (2014) estimated the trend of export growth rate and instability indices during the pre and post-wto periods of the fisheries sector in Odisha. The results indicated that production, growth and instability have been lower in the post-wto period compared to the pre-wto period. The production growth had slowed down because of lower growth in exports due to WTO conditions, but instability had declined mainly due to underproduction. In addition, the fisheries sector contributed to the national economy of India through food and nutritional security, export earnings, gross domestic product, employment, and has high potential for inclusive development. However, the slow growth and high instability remains a serious concern for the development of this sector. They suggest that government needs to make provision of primary, secondary and tertiary infrastructure facilities to achieve smooth and progressive growth of the fisheries sector.

In another study, Shah (2007) attempted to examine the management of fisheries development in the State of Maharashtra from (1979-1999) using time series secondary data of variety-wise fish production. The statistical tools such as coppock instability index and *t* test were used to study the growth and performance of fish production. The study concludes that in order to increase the overall fish production from marine capture and inland fisheries, there is a need for the government to initiate measures for reservoirs and culture fisheries. Kalidoss, Araya, Infantina, & Velmurugan, (2016) examined the performance and growth of marine fisheries in Tamil Nadu, to assess the status of marine fish productivity for the period 2001- 2011. They used the Compound Growth Rate (CGR) to study development of marine fisheries and uncertainty using Coefficient of variation (CV) and Coppock Instability Index method. Findings of their study showed that development and uncertainty performance was stable for the period from (2006-07 to 2010-11) than the previous years (2001-02 to 2005-06). They suggest that the government should develop strategies for social security of marine fishers in Tamil Nadu. A study by Jeyanthi & Gopal (2012) investigates the growth and instability of India's frozen scampi exports from 1995 to 2009. They examined the compound growth rate, market awareness and uncertainty indices of the India's scampi exports. They found that more than 80% of the scampi exports from India were exported to key markets viz., Japan, UAE, UK, Belgium, Netherlands, Canada, Germany and USA. The results of Coefficient of Variation and Coppock Instability index showed that there was high level of uncertainty for India's scampi exports.

The next section 2.4 discusses the economic and commercial analysis of the fishing crafts engaged in fishing business.

2.4 Studies on Commercial and the Economic Aspects of Traditional and Mechanized Fisheries Sector

Akanni (2008) examined the capital investment, catch and efficiency levels of artisanal fishermen in Lagos State, Nigeria, using primary data from 120 operators with manual propulsion fisheries (MPF) and 102 fishermen operating the motor-powered fisheries (MF) using the probit model. They found that the average weekly fish catch for MPF was 26.1 kg and for MF operators 60.0 kg which is very low as compared to the catch of big fishing vessels which operate with high horse power engines. The author suggests that technical competence of the MF operators could be improved by educating the fishers to make use of better fishing methods and provide them credit amenities to purchase required fishing equipment.

Tietze, Prado, LeRy, & Lasch (2001**)** made a comparative analysis of economic and financial performance of marine capture fisheries through the survey of 108 type of fishing vessels from 15 South American, Caribbean, European, African and Asian countries for the years 1999 and 2000. In this study it was found that out of 108 type of fishing vessels, 105 or 97 % had positive gross cash flow and fully recovered their operational costs. However, only three types of vessels i.e stow-netters in China, semi-industrial, industrial shrimp, bottom fish trawlers in Trinidad and Tobago were running into operational losses. The study finds that 92 vessels i.e. 85 % earned net profit after deducting the cost of depreciation and interest. The authors conclude that positive results were achieved because of higher prices paid to the producers. Bassey, Okon, William, & Umoh (2013) made a comparative analysis of the economics of aquaculture fish production among the farmers in Nigeria’s rivers states and AkwaIbom in South Nigeria. They used a statistical tool namely; budgetary analysis and descriptive statistics for comparing production, profitability and traits connected with fish production in Nigeria’s rivers states and AkwaIbom. The authors found that farmers of the Nigeria’s rivers states were highly efficient and their business was profitable as compared to AkwaIbom. This is because they had better awareness on aquaculture fish production. Further, the economic analysis of costs and returns of fish farming in Saki-East, Oyo State, Nigeria was carried out by (Tunde, Mp,Oladipo,&Olasunkanmi 2015). The primary data collected through questionnaires from fish farming community was analysed using the tool of budgetary analysis, multiple regression and descriptive statistics. The inferences of the cost and return analysis on fish farming showed that overall revenue was N244364.30 k for a cycle, while the total expenses were N129379.52 k for a cycle. The rate of return on investment was 0.8887 which indicates for each N1 invested, the return would be 88.8 k. The benefit cost ratio was 1.9 concluding that fish farming was profitable and fish farmers would continue their operations.

Another study appraised the marine fish production in the state of Gujarat viz-a-viz the potential yield. The cost-effective performance of trawlers and motorized gillnetters was measured. Also the supply pattern of marine fish in the internal market as well as the performance of marine fishery export was analyzed. They recommended policy measures to enhance production and marketing of marine fish in Gujarat (Devaraj, Sathiadhas, & Reghu, 1998). A study by Kanaga (2015) estimated costs and returns of marine fishing, economic efficiency and socio-economic profile of fish farmer's at Tharuvaikulam in Thoothukudi district in Tamil Nadu from 2014 to 2015. The data collected through random sampling method included 30 fishermen venturing for single day motorised fishing, 30 fishermen involved in multi-day motorised fishing and 60 fishermen owning mechanized vessels venturing for multi-day fishing. The study found that capital investment on fishing units differed based on craft size, engine type and number of gears owned. However, amidst the 3 fishing units, the expenses of capital investment were higher for the multi-day mechanized vessels. The author suggests policy intervention of the government for the development of marine fishing and welfare of the fisherfolk.

Soylu & Uzmanoglu (2010) examined the productivity and profitability of 23 fishery enterprises in Durusu (Terkos) lake in the Marmara region in Turkey in 2006-07 using Cobb Douglas production function. Results of multiple regression analysis showed an increasing return to scale in the fishery enterprises. The marginal productivity of inputs were determined as 2.15 TL for labour, -1.62 TL in food, 1.81 TL in fuel, 1.16 TL in maintenance and repair, 2.73 TL in capital depreciation and 2.88 TL in other expense. The average productivity was 102 and average profitability rate of the enterprises was determined as 1.50. The fishermen consider fishing as a secondary occupation and use traditional methods of fishing. The authors recommend that fishing should be subsidized. A study by Asamoah et al., (2012) used the Cobb-Douglas production function to relate production output to several independent input variables to determine the inputs that affect productivity pertaining to pond farmers in Ghana. The results showed that aquaculture exhibited increasing returns to scale concluding that an increase in inputs will more than proportionately increase the output. The study recommends that production function analysis is important to determine the factors of total fish catch per fishing trip.

Crentsil & Ukpong (2014) used the Cobb Douglas production function to estimate the factors of production which influence the output of fish catch using primary data from 45 fish farmers in the Amansie-West District of Ghana, West Africa. The results indicate that the variables, total area of pond, weight and size of fingerlings and feed had a significant and positive relationship with fish output ($p<0.01$). The production technology used revealed increasing returns to scale. The authors suggest that there is a need to estimate the cost functions and economic efficiency of fish production to enable fish farmers to reduce the cost of production toward efficient, optimum and profitable output. The authors recommend changes in public policy to improve yields of existing fish ponds with reference to the total pond area, feed and the number or weight of fingerlings, which have strong correlation with (yields) of fish output increasing fishermen earnings.

In another study, Najmudeen & Sathiadhas (2007) assessed the economic efficiency of the mechanized trawlers functioning at two key landing centres at Neendakara and Munambam at Cochin fisheries harbour along the Kerala coast. They used Cobb-Douglas production function theory to study the connection between different outputs and the inputs of 50 mechanized trawlers in Kerala, India, from 1998 to 2003. Findings of their study suggest that there is scope to improve net income of trawlers if they increase fishing days at Neendakara and Munambam. The authors suggests that at Neendakara landing centres, the number of fishing days in a year could be extended from 193 to 204 and in Munambam from 203 to 229 days to obtain maximum profit.

Kurien (1982) evaluated growth and development in fishing and its impact on fishermen in Kerala and found that there was an increase in fish production due to the adoption of mechanization. Further, Pattanayak (1988) reviewed the progress made due to mechanisation of fishing crafts which commenced in the coastal state of Karnataka during 1957-58. The state initially had only two small mechanized boats in 1957, which increased to 398 purse seiners in 1987. The study finds that the state had progressed in marine fisheries due to its vast fisheries resources and diversification in mechanized fishing. Almost 85 % of the total marine fish landings were contributed by two deep sea trawlers, 731 gillnetters and about 1,500 shrimp trawlers. The study found that during January 1987 to March 1988, marine fish production was 1,29,659 tonnes, valued at ₹48 crores. The fishermen made effective use of large mechanised vessels to venture into deep seas and for multi-day fishing, particularly for sardines species. Further, Appathurai (2015) examined the impact of mechanization on marine fishing industry in the district of Kanyakumari. The primary survey was conducted using sampling method among mechanized and motorised fishing craft boat owners. This study analysed the impact of mechanization on fishermen's income that have shifted from traditional to mechanized fishing and found that it had a positive impact on the fishing industry in Kanyakumari.

Rayen (2016) studied the impact of mechanization on the fishermen in the district of Kanyakumari. The author found that mechanization has led to several changes such as fishermen shifting from traditional to mechanized fishing, creation of employment opportunities and increase in income through fishing thereby increasing the GDP of India. However, the fishermen owning mechanized vessels still did not use technology and were affected by socio-cultural, political, and economic factors. The study suggests that it is necessary for the government to initiate necessary steps to improve livelihood of fishermen owning mechanized vessels in the district of Kanyakumari. Another study by Hassan & Sathiadhas (2009) examined the functioning of trawl fishery at Cochin Harbour in Kerala for the entire season in 2005-06. The study found that the mechanized sector is overcapitalized and there is an increasing trend in capital investments by fishermen in fishing crafts as well as fishing gears. The multi-day trawl fishing units were economically effective but they released lot of discards and waste material affecting sustainability of the marine fish resources. The authors suggest that there is a need for the government to intervene and use quota system to control the number of increasing trawlers in the state to effectively administer marine fishery resource of the state.

A study by D'Cruz (2004) examined the issues of artisanal deep-sea fishing in the state of Kerala using primary and secondary data. The study found that deep-sea fishing policies (DSFP) by Government of India in 1991 had showed great impact on the exploitation of deep-sea fishery resources in India. Kurien & Willmann (1982) made a comparative study of the costs and earnings of 242 fishing units of mechanized and artisanal fisheries operating in 15 different villages along five districts of the Kerala coast. The results of the study indicated that artisanal fishing units profitability, productivity and contribution to the national economy were better than mechanized fishing vessels. The authors suggest a need for allocation of more resources and development of technology for the artisanal sector. Hence, they recommend that there is a need for the government for policy formulation, extension of credit schemes and subsidies for fisheries management. Narayanakumar, Sathiadhas, & Aswathy (2009) examined economic performance of marine fishing methods in India by analysing costs and returns from various fishing craft-gear combinations along the east and west coast of India. The study found that trawlers which venture for multi-day fishing (MDF) for 6-10 days, earned higher returns, had higher capital and labour productivity on the west coast as compared to the east coast. The single day gillnet fishing technique was economical as compared to multi-day fishing. In the case of non-mechanized fishing method, the capital productivity was high with a lower ratio extending from 0.36 for the gill net operation on the east coast to 0.51 for the same on the west coast. The authors conclude that multiday fishing for 3-5-days using various fishing methods provided economic benefits to the fishermen.

Further, Shajeeva (2016) examined the impact of increase in the engine power on the performance of different size trawlers of Thoothukudi fishing harbour. The study found that there were three different size trawlers operating with overall length (OAL) of 40-50ft, 50-60ft and above 60ft. Almost 50% of the trawlers had OAL above 60 feet which used horsepower engines ranging from 400 to 600. The study showed that seven trawl net designs were used and the author suggested that there was a need to optimize fleet strength for the Thoothukudi fishing harbour.

A study by Narayanakumar et al., (2009) evaluated economic performance of various fishing crafts in India through primary data from the fishermen owning motorized, mechanized and non-mechanized sample fishing units using different fishing craft-gear combinations and operating along the east and west coast of India. The variables used in the study are operating costs, initial investments and returns per trip of various fishing units in India. The findings of the study indicated that multiday fishing operations using various fishing methods operating on economies of scale provided the economic benefits to fishermen. However, the fuel consumption on these crafts accounted for about 50-60% of the operating cost. The authors suggest that alternative fuel such as bio-diesel should be utilized to substitute fossil fuel due to the impending oil crisis. The fishers can also follow the potential fishing zones (PFZ) to reach the fishing ground easily instead of spending time and expenditure on fuel for searching shoals of fish.

N.Aswathy, Narayanakumar, & Kuriakose (2014) analysed economic sustainability of marine fish production in India for the period 2000 to 2010 by considering gear and species-wise marine species and fish prices in various maritime states of India. They used total factor productivity approach to measure production of all inputs and the effect of using technology on output. The study found that 76% of costs were incurred on fuel by the trawlers, 12% by dolnetters, 9% by gillnetters and 3% by others. Another study by Geetha et al.,(2014) compared the economic efficiency of the trawlers and mechanised gillnet units operating in Chennai in Tamil Nadu. The authors found that average costs of operation and net income for single day or multiday gillnetters was ₹ 6,613 and ₹ 17,757 while net income for a day and costs of operation for multi-day trawlers was ₹ 3,219 and ₹ 18,095 respectively. The performance of gillnet units was due to better price for tuna fishing. The study concludes that mechanised gillnetters had high capital and labour efficiency as compared to the trawlers.

Bose & Sarma (2010) examined the cost and returns of 120 Sona and 60 Sora type of mechanized fishing boats in Visakhapatnam. Variables used in the study were total variable costs, total quantity, value of catch, and profit per annum of mechanized boats. The statistical tools chi-square test was used to find the association between costs and returns of mechanized fishing boats. The study found that average costs of Sona type boats is more than Sora type and this difference was due to size, engine capacity and use of modern equipment. Their study found that variable costs, volume of fish catch per annum, labour employed, depends on the type of boats and fuel was major part of the costs. Costs incurred on food per voyage on Sona type boats were higher as compared to Sorra type boats. Sona types of boats were expensive but provided more employment in the mechanized fishing operations. They suggest that fishing communities should be provided with credit, marketing and other infrastructural facilities by the government to increase their income. N. A. Aswathy, Shanmugam, & Sathiadhas (2011) analysed returns and expenses of the mechanised sector and effect of the fishing ban on the fishers livelihood in the state of Kerala during 2007. The samples used in the study are mechanised fishing units consisting of gillnetters, purse-seiners and trawlers on the key harbours, namely; Beypore, Munambam, Cochin, and Neendakara. The study found that the economic performance of fishing operations are affected by several factors such as change in revenue, low catch per unit of effort, increase in the key input of factors of production, cost and effort restrictions.

N. Aswathy, Narayanakumar, Harshan, & Ulvekar (2017) examined economic performance of purse-seiners and trawlers, using random sampling method at Karwar Fishing Harbour in 2011. The assessment of fishing operations and profitability was done using financial and economic indicators. Purse-seine vessels contributed 85% from species such as mackerels and oil sardines. Trawlers contributed 50% from species such as flatfishes and shrimps. The capital productivity was high (0.49 as operating ratio) for purse-seiners when compared to trawlers (0.73 as operating ratio). The financial and economic performance indicators showed that ratio of net benefit-earnings was (0.43), benefit-cost ratio was (1.75) and internal rate of return (IRR) was (117%). The authors suggest that investing on purse-seine vessels is more beneficial to the fishermen as compared to trawlers. A study by Sushil, Tousif, Chaudhari, Shirdhankar, & Singh Dhaker (2017) analysed the catch composition of purse-seine fishing of 167 purse-seine vessels from Mirkarwada fishing harbour of Ratnagiri district and 288 purse-seine vessels operating along the Maharashtra coast. Data was collected from August to May for one fishing season from purse-seine owners through random sampling method. The authors found that during the entire fishing season, landing of Indian mackerel was observed in all the months, but there was a decline in the catch of sardines, tuna, horse mackerel and Indian oil sardine. Another study by Pravin & Meenakumari (2016) reviewed the Indian purse-seine fishing in India and found that using the purse-seine power block enhances efficiency of the vessel and reduces the drudgery of the crew. The author also suggests that there is a need for the government to control minimum legal size for harvested species, mesh size of gear and improve fishing capacity, vessel capacity, and minimum legal size of harvested species.

The reviews on fisheries sector which plays an important role in improving the socio-economic status of the fishermen is discussed in the next section.

2.5 Studies on Impact of Socio-economic Factors Affecting Fishing Business

A study by Al Jabri, Collins, Sun, Omezzine, & Belwal (2013) analyzed factors that determine small-scale fishermen's income on Oman's Batinah coast. The study found that almost 30 percent of Oman's population was small-scale fishermen. Variables such as fishing inputs, catch, increase in engine power, length of the boat, fishermen weekly catch, and number of weekly fishing trips had positive impact on the fishermen's income. Furthermore, socio-economic and demographic characteristics also contributed significantly in determining the fishermen's income. Variables such as fishermen's exchange of information, cooperation with ministry and fishermen's involvement in the extension activities had positive effect on fishermen's income. However, increase in weekly fishing costs, number of crew members, and difficulty in getting ice had a significant negative impact on the income. The Wilayat (local administrative units) did not provide co-operation to make any significant impact on fishermen's income.

Jeyarajah,S.&Santhirasegaram (2015) analyzed socio-economic characteristics of 370 fishermen households engaged in small scale marine fishing and operating in the Batticaloa district in Sri Lanka. They also explored the socio-economic factors which contribute to the per capita income of Sri Lanka. The statistical tools used were descriptive statistics and regression method. The study reveals that 35.4% of the respondents were between the age group of 31 to 40 years and literacy rate of the respondents was 87%. Average size of the family of small-scale fisheries households was four and average monthly income was 18,284 Sri Lankan rupee. Findings of the study reveals that variables namely, gender, age, family size, marital status and value of fishing equipment were individually significant and contributed to the per capita income of small scale fisheries households in the Batticaloa district.

Adili & Antonia (2017) in a case study assessed the determinants which influence fishing income of 120 households living in the coastal areas of Mafia District, in Tanzania. The result revealed that for 41.47% of the households fishing was a major economic activity for their livelihood with average income per day of 24.41 USD (51250 TZS); whereas, fish related activities contributes 7.14 USD (15 000 TZS) and other economic activities 2.38 USD (5000 TZS) per day. The authors conclude that fishing contributes to higher household's income compared to other activities. They suggest that government and other stakeholders should provide credit facilities and subsidies to fishermen to purchase improved fishing gears to increase their income to maintain sustainability. A study by Rahim & Dwi Hastuti (2018) estimated income of 107 traditional fishermen households i.e. 69 using outboard motor boats and 38 using non-powered motor boats in the coastal areas of Barru District, South Sulawesi, Province, Indonesia. The study used multiple regression model and found that variables, such as education of head of household, education of fishermen's wife, number of dependents, housing of fishermen significantly affected household income of the traditional fishermen. However, age of the head of household fishermen had no significant impact on the fishermen households' income.

Venkataraman & Sathiadhas (1981) analysed the impact of mechanized fishing on the socio-economic condition of fishermen of Sakthikulangar-Neendakara in Kerala. The study attributed a rise in the level of indebtedness of the fishermen households due to the bank loans taken to purchase fishing vessels. However, results showed that there was improvement in housing, literacy, employment, infrastructure, production, exports and earnings of the fishermen in Kerala. Another study conducted by R. Narayana Kumar, K.K.P. Panikkar (2000), in Karnataka assessed the socio-economic impact of mechanization on traditional fishermen operating '*Rampon"* gears. The authors found that the introduction of commercial purse-seine vessels had affected the income of "*Rampon*" fishing operations of the traditional sector. Further, Narayanakumar, Panikkar, Sehara, & Sathiadhas (2000**)** examined socio-economic status of fishermen households in coastal areas in India involved in marine fishing using parameters such as age, educational qualification, occupation, family size, customs, trusts and their living standards. The tools such as production function and regression were used to analyse socio-economic factors and it was found that automation of fishing industry and use of fishing equipment has led to increase in income and employment of the fisheries sector. However, it was found that literacy rate was very low among the fishermen. Hence, the authors recommend that the government should take appropriate measures to improve level of literacy among the fishermen population in the coastal areas. Another study explored the socio-economic conditions of the culture fishers in India and it was found that fishers generally have less education and live under inadequate housing conditions. The fishers support their family members with low income and borrow to meet their financial needs. The study suggests that there is a need for the government to provide financial support to fishing community to improve the overall fisheries productivity of India (DeviNongmaithem & Ngangbam, 2014).

Datta & Kundu (2007) study on the socio-economic appraisal of fishermen involved in aquaculture in West Bengal found that without definite improvement of fishermen's socio-economic condition, inland fishery development itself will be at stake. Desperate living standards, differential access to income earning capacity and other amenities create discontent among fishermen and weaken their motivation to participate in fishing activity. The study suggests that government could provide fishermen ameliorative measures such as health insurance, better training, credit facilities, reclaim unused wetlands and need based public grants to improve their socio-economic status. A study by Salim et al., (2013) examined social status of fishers in India using primary data from January to December, 2011. The authors found that in order to ensure a decent livelihood security, fishermen tried to generate their income beyond fisheries such as agriculture, labour, business and non-farm activities. The study recommended that microfinance initiatives like self-help groups (SHGs) need to be encouraged to support the fishers to meet their financial requirements. There is also a necessity to train the fishers, mainly the young and womenfolk on fisheries management. S. T. Kumar & Shivani (2014) analysed socio-economics status of the fishers in Odisha on the basis of governmental targeted policies. The study found that there were inequalities in living standards, absence of basic amenities and discontentment among fishermen which affected their motivation to participate in marine fishing activities. The study concludes that appropriate formulation and implementation of developmental programmes are the keys to improve the socio-economic condition of the fishing community in Odisha.

Rao et al., (2016) analysed spatial and progressive changes in demographic and socio-economic indicators of the coastal fishing community of India. The statistical tool, three factor ANOVA was used to examine the significant differences in gender and age. The results showed that the fishermen belonging to below poverty line had small family size rather than large sized families. A study by Jeyanthi, Balasubramaniam, & Jeeva (2016) on socio-economic status of boat owners in Nagapattinam using motorized FRP boats finds that the average daily per capita income earned by the fishermen was ₹ 1,256 and was same as poverty line given by

World Bank of ($1.25 per day). They used percentage analysis and Gini-coefficient with reference to Lorenz curve to assess the income inequality. Another study by Salim, Narayanakumar, Sathiadas, Manjusha, & Antony (2017) used the primary cross-sectoral data of 567 fish farmer households in Kerala from Jan to Dec 2011 to assess their livelihood security, health, income and literacy. The study found that most of the fisherfolk were in the age group of 36-55 years with small family size and better rate of literacy. The fishers spent major share of their income on food expenditure. Since fishing operation are seasonal and due to higher period of gestation in the culture sector, fishers were involved in other occupations such as agriculture, labour, business, services and others to increase their income. The author suggests a need to implement extensive developmental plans for the betterment of the fishing community.

In another study, Chakraborty (2016) studied the socio-economic condition of fisherman of Bali Nolia Sahi village, Puri in Orissa. The study shows that the socio-economic condition of the fisherman were not good in terms of education, and housing conditions. As regards fishing, fishermen do not get much government support, they lack basic necessities of fishing and hence fishing has not developed in the State. The authors suggest that fishermen should be provided with cold storage facilities and motorized boats. Education programmes and literacy awareness should be created right from school level for fishermen children so that they adopt modern technologies of fishing which will help them to increase their income and socio-economic status. The financing policies at low rate of interest need to be implemented by policy makers so that fishermen would not depend on money lenders and middlemen who exploit them. In addition, the Fisheries Department could innovate development programmes for benefit of the fishing industry. Prathap (2013) studied financial inclusion of fishermen households and role of microfinance in coastal Kerala using primary and secondary data. The statistical tools used for data analysis were percentages, averages, multiple and binary logistic regression. Results of the study showed that one third of the households in marine fisheries sector are still marginalized with limited or no access to basic financial services such as microfinance. However, those fisher households who were members of self-help groups in coastal Kerala, were having higher levels of financial inclusion and availed microfinance facilities to improve their socio-economic status.

The role of government towards the fisheries sector and fisheries co-operative is reviewed in the next section.

2.6 Studies on Role of Government towards Fisheries Sector

The economics of subsides are important to understand (i) why governments use subsidies and (ii) its impact on international trade. Considering various subsidies, export subsidies, post-harvest and fisheries development infrastructure subsidies are deemed to be harmful subsidies. The grants, subsidies for procurement of modernizing boats, fishing gears, engines, other equipment such as GPS, iceboxes, fish finders and communication systems in mechanized fishing sectors and tax exemption for high speed diesel fuel are affected by the WTO rules (N. Aswathy & Salim, 2012). A study by LeRy, Prado, & Tietze (1999) showed that marine capture fisheries is financially and economically feasible and creates adequate revenue to cover the cost of depreciation. The countries included in the studies are Thailand, Peru, Senegal, Argentina, Taiwan Province of China, Spain, China, Republic of Korea, Indonesia, Malaysia, India, France, Ghana, and Germany. It is found that in contrast to emerging nations, the European Community (EC) provides extensive support to the fisheries sector, such as reduced tax on fuel, capital subsidies, minimum price for fish catch and compensation for non-fishing days. Another study by Isaksen, Hermansen, & Flaaten (2015) analysed fuel subsidy given to Norwegian fishermen which is exempted from taxes. This reimbursement of fuel taxes on subsidy has been continued under various governments since 1980’s. The country-wise fishing fleet is heterogeneous regarding oil consumption and fishing procedures. The study found that during 2011, fuel taxes exempted for the fishing fleet was Norwegian Krone (NOK) 999 million, amounting to 6.3% of the landed value, against NOK 772.7 million (6.4% of landed value) in 2007. The study showed that fishing industry is export-oriented, provides food sources and competitive with other countries to a great extent. Lee & Midani, (2013) examined the impact of fuel subsidies on level of fishing effort in South Korea. Their study showed that fuel subsidies had a significant impact on fisheries sector all over the world and more subsidies lead to more fishing efforts leading to overexploitation and depletion of resources. The authors suggested that government in turn should control overfishing to protect marine resources.

K. Sunil Mohamed, (2016) debated on global status of fishing using LED lights and regulations followed in other countries. The use of LED lights in purse-seine fishing in Goa and Karnataka led to conflicts between fishermen belonging to traditional and mechanized sector. In Karnataka, there was growing resentment from traditional sector against fishermen with mechanized purse-seine vessels, using LED lights to catch fish and earning high income. The traditional fishermen in Goa were of the view that LED fishing affects marine ecology of the region as it captures excessive large species of fish reproducing adults. The conflict between the traditional fishermen and mechanized sector escalated in Goa, so much that the Government of Goa was forced to order a ban on the use of LED and other light attractants in fishing practices within the territorial waters of Goa. However, in spite of the ban, LED fishing is still practiced by purse-seine fishers using purse-seine vessels, because of lack of strict government control and supervision.

Nayak (2007) examined the socio-economics of the fishing community by interviewing 100 fishermen from the coastal talukas of Karwar, Ankola, Kumta, Honnavar and Bhatkal of Uttar Kannada District and also fishermen intermediaries and co-operative societies. The fisheries co-operative societies provided facilities such as assembling of fish at the seashore, transport, packaging, weighing and marketing to the fishermen, thus playing an important role in fishery trade. The authors recommend that government and fisheries co-operatives should initiate proper steps in order to exploit the available resources and improve socio-economic condition of the fishermen. Jakati (2011) in a research study finds that in Goa the fisheries co-operative societies across jetties played an important role and operate for the benefit of fishermen. These societies help fishermen to sell their fish catch to the fish merchants. They also cater to a common interest of the fishermen community.

Chandrashekar,(2014) analysed growth of fishery co-operatives and problems faced by co-operative fisheries sector in India. The author finds that there is a positive and stable growth over a period seven years. Though there is little variation in the growth rate of membership, it is also growing positively. This clearly indicates that fishermen are interested in these types of societies. However, there is a need to coordinate between the Government of India and State Governments to achieve continued growth in the fishery co-operative sector for the upliftment of the fishermen.

2.7 Studies on Problems Faced by Fishermen

Hossain (2014) analysed the impact of various factors of fish production on socio-economic condition of fish farmers in Bangladesh as well as the problems faced by them. The descriptive analysis showed that a large proportion of fish farmers had formal education and financed their fish production through personal savings. The multiple regression results showed that fish output is determined by the cost of labour, feeds, fertilizer and pond size. The coefficient of determination R^2 is 0.473 which indicates that 47.3% of the variation in the value of fish output was explained by pond size, cost of labour, fertilizer and feeds. Most of the farmers improved their socio-economic condition through fish cultivation which helped them to increase their income, education and acess better health facilities. The major problems encountered in fish production were lack of capital, volatile market price and fishery department office in the district who were not capable to help the fishermen. The author suggests that government should take measures to solve problems which will help fishermen to increase fish production, create employment opportunities to alleviate poverty.

Venkatachalam (2005) examined fisheries sector in the Indian sub-continent of Gulf of Mannar. There were conflicts between the traditional and mechanised sector due to trawling techniques. The study showed that most of the fishermen in traditional sector claim that trawling method of fishing used by mechanised sector tends to reduce the fish catch. This has affected the income and livelihood of traditional fishing communities. Another study examined the status of marine fisheries and the problems faced by the traditional fishermen due to an increasing competition from mechanised boat owners of Tamil Nadu. The author suggested importance of diversified techniques in maximising production to improve productivity of artisanal fishermen. Further, the author asserts that there is a need for the government to financially help large number of small boat operators rather than only supporting a few large boat operators (Sreenivasan, 1978)**.**

Phukan, Mall, & Mishra (2015) analysed challenges encountered by 200 fish farmers in the Cachar district of Assam. Fish farmers face many problems and constraints such as technical, financial, ecological, production, commercial, and market-related. In their study it is found that a major challenge is the absence of effective supply chain facility. The study concluded that policymakers and government should educate and train the fishers on modern means of farming and improve the supply chain management. Marimuthu & Valliammai (2016) sought to examine total fish production in the marine sector of India, socio-economic conditions of fishermen families and problems and prospects of 66 fishermen in Nagapattinam in India. Statistical techniques such as descriptive statistics, frequency, percentage and multiple regression, and F test were used for analysis. It was found that mechanized boat owners made heavy capital investment in engines but lack technical skill and knowledge of operation. The study concludes that there is a need to provide opportunities for fishers to earn high income by improving their socio-economic conditions.

Another study by Sathiadhas, Narayanakumar, & Aswathy (2012) showed that marine fisheries sector of India has been transformed from the status of subsistence fishery to multibillion-dollar industry due to technological advancements in harvesting and post-harvest operations. However, since 1980, the intensive shrimp trawling with multi-day fishing trips, introduction of purse-seines and an increase in overall fishing effort have resulted in a decline of fish catch. Marine fish production in the states like West Bengal, Orissa, Andhra Pradesh and Tamil Nadu on the east coast increased, whereas the marine fish production declined on the west coast states such as Maharashtra, Goa and Gujarat from 2000 to 2010. The authors conclude that decline in the fish catch of high-value species of fish will have a serious impact on economic sustainability of marine fisheries sector and livelihood of the fisherfolk. A study by (Vivekanandan, 2011) shows that the fish epidemic, high cost of production, seasonal variation in catch has reduced the shrimps production in India.

Kamath et al., (2016) found that during the last 30 years, the use of technologically developed vessels such as trawlers and purse-seines, have harmed the ecology. The trawl fishing methods have destroyed the breeding grounds of shrimps, mackerels and other small crustacean fish families. Conventional and technological method of fishing always has been a dispute between the fishermen belonging to the mechanised and traditional sector. The fishermen in the traditional sector in Goa use the “*Rampon*” net and fishing is the only source of livelihood to them. Dwindling fish catch for traditional fishermen results in survival problems for smaller artisanal fishermen. Some fishermen couldn’t move to the mechanized sector due to poverty. The study concludes that information regarding the subsidies provided by the government and the latest fishing techniques have also not reached many of the fishermen.

A study by Jakati, (2011) shows that government in Goa has restricted the mesh size of net to a minimum of 24 mm in order to prohibit catching juvenile fish. Even though there are such rules, fishing vessels utilize nets with mesh size of 15 mm due to which juvenile fish is caught affecting fish life cycle severely. This results in decrease of fish catch. Apart from such problems, there are certain problems like inadequate workshops and lathe to repair the equipment like GPS, nets, fish finders and insufficient cold storage plants to store the fish catch. Further, present-day youth shy away from career of fishing. Influx of migrant labour from outside Goa and problems created in the repayment of loans because of low catch also affect the fishing industry in Goa.

The next section discusses the research gap emanating from the review of earlier studies.

2.8 Research Gap

The literature on fish production (marine and inland), marine exports, economic analysis and commercial aspects of motorized canoes, trawlers and purse-seine vessels and role of government to support fishing industry have been reviewed for the purpose of this study to find the research conducted on the economic and commercial aspects of the fishing industry. Studies relating to economic analysis of the mechanized and traditional fishermen are also concentrated across the globe and in the coastal states of India like Kerala, Tamil Nadu, Maharashtra, Gujarat and other coastal states of India. The CMFRI publish annual reports giving the database of marine production and MPEDA about marine exports in all the states of India. According to Central Fisheries Board, conventional and technological method of fishing used by the fishers in Goa has always been a dispute. The productivity of traditional fishermen was hampered due to dwindling catch by intervention of the technologically developed mechanised vessels such as trawlers and purse-seines during the last 30 years.

A research study conducted by Shreekanth, Manju Lekshmi, & Singh, (2015) found that marine fish is in great demand in the state of Goa. According to their study, out of the total fish production, 97% is from the seas. CMFRI (2013) reported that as much as 1.85% of the fish landing of India is from the state of Goa. Another study estimated that maximum sustainable yield (MSY) for marine fisheries of the coast of Goa were 70,295 tonnes per annum (Parulekar, 1989). Subsequently, in another study by Monteiro (2006) the maximum sustainable yield calculated based on the catch and efforts over the years was found to be 85,407.61 tons in 2006. The study by Gaonkar, Rodrigues, & Patil, (2008) on fishery management in Goa examines nature of the fishermen community, impact of political decisions on fishing community and issues confronting the fisheries sector. Their study analyzed fixed costs, variable costs, gross revenue and gross profit of traditional, motorized, nonmotorized and mechanized sector for the year 2004 and suggests sustainable fisheries development in Goa.

Problems and issues of the fishing industry differ from region to region. Hence, there is every need to have micro level studies to evaluate economic and commercial aspects of traditional motorized and mechanized fishing crafts in Goa.

1. Several researchers have acknowledged the importance of the fishing industry providing food security, nutrition, employment and its contribution to the economy and aquaculture in contributing more than marine production. The reviews also show that increase in fish production due to mechanization has resulted in depleting of fish resources but also has improved fishermen's socio-economic status. Review of marine exports reveals that infrastructure facilities have to be improved in India to develop sea food industry to earn more foreign exchange. The review of literature in this chapter reveals that no research has been done on many important aspects of fishing industry in Goa, such as the contribution of the fishing industry to the primary sector and to the state income as well as the fish production trends, CAGR in fish production (marine and inland), marine exports, and jetty-wise marine fish catch. None of the previous studies have compared and looked into contribution of Goa's fish production (marine and inland), to the nation's production and to the world. No studies are also done as regards the destinations-wise marine exports from Goa to different countries of the world. This study will analyze the fish production trends from 1990 to 2017. There are reviews which focus on the growth of marine exports, Coppock instability index and Coefficient of variation of other marine states of India. However, there is literature lacking on share of marine exports of Goa to the country and to the world as well as Coppock instability and coefficient of variation for India, world and Goa for the period 1990 to 2017. This study will fill this research gap. The present study uses

the semi-log regression model to study the CAGR of fish production, marine exports and ranking method for destination wise marine exports from Goa to different countries of the world for the period 1990 to 2017.

2. Most of the research concentrated on the economic analysis of the artisanal, motorized and mechanized fishing vessels as well as fish farmers in aquaculture. The variation in capital investments, costs, earnings and profits of the different size of motorized canoes, trawlers and purse-seine vessels in the two districts of Goa for motorized canoes and across the four jetties for mechanized vessels has also not been recognized by any academic study till date. So also there is no in-depth study undertaken on the commercial and economic aspects of traditional motorized canoes and mechanized fishing vessels operated by fishermen in Goa. Studies which identify the factors that are directly and indirectly related to income of fishermen can be rarely found in the case of Goa. There are no studies done on the socio-economic factors affecting the net profit, earnings and savings from fishing business of the fishermen owning motorized canoes, trawlers and purse-seine vessels. Till date there are no studies done in Goa on the impact of input of factors of production which affect the output of fish catch of the fishermen owning motorized canoes, trawlers and purse-seine vessels. In order to fill this research gap, the present study uses the linear multiple regression model to study the impact of socio-economic characteristics of fishermen on their net profit, earnings and savings from fishing business. It also uses the Cobb Douglas production model to study impact of the input of factors of production on the output of fish catch. Therefore, the present study aims to narrow down this research gap to the important livelihood sector of the coastal fishermen in the study area.

3. There is also no research done on the role of the Government in promoting sustainable fisheries through its various schemes. Role of the Government of Goa in terms of disbursements of schemes through (subsidies, grant in aid, supplies of materials and contribution) for the sustainable growth of fishing industry as well as for welfare of the fishermen has not been investigated. Trends and growth of government schemes is also an important problem in any research investigation and hence it deserves to be examined. The CAGR method is used to analyze growth of the schemes given to the fishermen in this study. The satisfaction level of fishermen towards the schemes availed by them also has not been previously explored in the

State of Goa. The satisfaction level of the fishermen with regards to economic and social factors affecting their fishing business is examined in the present study. The challenges and problems faced by the fishermen in fishing business also deserve an in-depth analysis. This study is a humble attempt to fill that research gap. The ensuing chapters make a systematic, comprehensive attempt in that direction.

Chapter 3

Research Methodology

Chapter 3

Research Methodology

3.1 Introduction

This chapter provides in detail the research methodology as well as tools and techniques used in the present study. This study aims and contemplates to achieve the research objectives by application of econometric techniques and statistical tools such as parametric and non-parametric tests. The study relies extensively on time-series secondary and cross-sectional primary data for the purpose of data analysis. In the present study, researcher aims at examining the contribution of fishing industry of Goa to the state gross domestic product (GSDP) through an in-depth analysis of secondary time series data from 1990 to 2017. This study also analyzes trends and growth of marine and inland fish production, marine exports at the international, national and Goa level using secondary time series data from 1990 to 2017. The study uses primary data to analyze the variation in capital investments, costs, earnings and profits of the traditional motorized canoes and mechanized fishing vessels owned by fishermen across the two districts in Goa. The study also examines role played by the government through schemes for the benefit of fishermen in Goa.

This chapter is organized into nine sections and is arranged as follows. Section 3.2 explains the operational definitions used in the present study, section 3.3 propounds the theoretical base supporting the study, section 3.4 describes the data sources, section 3.5 elaborates the sampling design, 3.6 specifies the variables related to the study, section 3.7 states the hypotheses formulated for the study, section 3.8 lists various statistical and econometric tools used in the study, section 3.9 presents an overview of socio-economic characteristics of the sample respondents, while section 3.10 provides the summary.

3.2 Operational Definitions

The main concepts used in the study have been as follows:

i. *Gross Domestic Product (GDP)***:** It is an indicator of economic performance of a country. It is the monetary measure of market value of all the finished goods and services that are produced by a country within the given period of time (Ocean Health Index, 2018).

ii. *Motorized canoe*: As per the Fisheries Department, Goa, motorized canoe is a defined as a “Light weight boat of wood or fibre reinforced plastic (FRP) used to catch fish by the traditional fishermen in the sea, lake or river using an outboard or inboard motor of 8.8 to 9.9 horsepower motor”, (Goa, Fisheries Rules, 1981).

iii. *Mechanized fishing vessel*: The Goa Marine Fishing Regulation Act 1980, as amended in 2016, defines "Mechanized fishing vessel" as a ship or a trawler fitted with mechanical means of propulsion and includes country canoes and canoes fitted with an inboard or outboard motor of the capacity above 10 horsepower" (Government of Goa, 2016). It is a fishing vessel which operates in the sea beyond 5 kms and can venture upto 12 nautical miles in the territorial waters of Goa to exploit living aquatic resources.

iv. *Fishermen*: It is a person (male or female) who is involved in carrying out fishing activities with the help of canoe/vessel either himself as well as with the help of labour. According to CMFRI Census of India (2010), marine fishermen are those who are engaged in marine fishing activity whereas traditional fishermen are those born in the fishing communities whose ancestral occupation is fishing.

v. *Fish landing centre*: According to Marine Fisheries Census of India, CMFRI (2010), fish landing centre means the place or harbour where the fishermen land their fishing craft with catch. In the present study area, motorized canoes land at fishing ramps and mechanized fishing vessels (trawlers and purse-seiners) land at fishing jetties.

vi. *Fishing gear* (*net*): As per Goa, Daman and Diu Fisheries Rules, 1981, fishing gear is any trap used to catch the fish either fixed in the soil or river bed or made stationary in any other way in a creek, canal, river, stream water or sea.

vii. *Fish catch*: It is the share which fishermen will get by operating the motorized canoes/mechanized vessels and fishing gears.

viii. *Income from fishing*: It is the income received by the fishermen by sale of fish catch by carrying out fishing and fish related activities.

ix. *Fixed assets*: The cost incurred for acquisition/building of fishing motorized canoes/mechanized vessels inclusive of all the other equipment used on the fishing craft.

x. *Fixed costs*: Fixed costs are incurred in the fishing business even when the fishing crafts are not in operation. In the present study, fixed cost includes depreciation on the fishing crafts and other fishing equipment, taxes, interest on the loan, annual insurance on mechanized vessels and crew, net and license fees, fishing pass (amount paid per fishing trip), contribution by fishermen towards the maintenance of jetties and also to the fishermen associations and fisheries co-operative societies. In fishery business, cost of depreciation is the permanent and continuing decline in the value of fixed capital asset used for carrying out fishing activities. This study computes the depreciation on the initial investments on the cost of hull of the fishing craft, engine, amount to modify the vessel, equipment, reconditioning (major repairs) and purse-seine block, is taken at the rate of 10%, assuming a life of 10 years. Depreciation on cost of fishing gear is taken at the rate of 25%, assuming a maximum life span of four years, as fishing gears get spoiled easily due to continuous use. Depreciation is calculated on straight line method. The rate of depreciation is considered in line with literature review and respondents views.

xi. *The operating costs* (*variable*) *costs*: The operating costs are incurred on canoes/ mechanized vessels when they are in operation. In line with the review of literature, this study calculates major components of operating costs by adding together cost on fuel, wages, food, ration, and "*batta"* i.e. commission to the labour, costs of ice, repair and maintenance, cost of oil and lubricants, costs of mending nets, marketing and transportation cost and other miscellaneous expenses.

xii. *Total Cost*: It is the sum of operating costs and fixed cost on fishing craft.

xiii. *Catch*: Any activity that results in killing of fish or bringing live fish which is not prohibited by the government on board the canoe or mechanized vessel.

xiv. *Gross revenue***:** Gross revenue is calculated from the species composition of the catch and the price of species of fish (Panayotou & Jetanavanich, 1987). The gross revenue/earnings are calculated by multiplying the quantity of species caught in kgs with the landing price of the species per kilogram. The gross revenue is calculated as per equation 3.1 in the present study.

$$GR\sum_{i=1}^{n} qi\ x\ pi \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{3.1})$$

Where, q^1 is the quantity of catch in kgs of the i^{th} variety, p^1 is the price per kg of fish of the i^{th} variety. Geetha et al., (2014) used the concept of gross revenue in their study.

xv. *Gross Profit*: Gross profit is the difference between the gross revenue (earnings from fish catch) and total variable costs (operating costs).

Gross profit=Gross revenue (earnings)-Total variable cost……………………. **(3.2)**

xvi. *Net profit*: The net profit is the difference between gross profit and fixed cost.

Net profit= Gross profit – Fixed cost…………………………………. ……… **(3.3.)**

xvii. *Savings of the fishermen*: It is the excess of income earned from fishing business over expenditure incurred for fishing activities by the fishermen.

xviii. *Catch per trip*: Catch per trip is computed by taking the total fish catch (in kgs) divided by total number of fishing trips.

xix. *Gross revenue* (*earnings*) *per trip*: It is estimated by taking the total earnings and dividing by the total number of trips.

xx. *Government schemes*: It includes subsidies, supplies of material for fishing, grant in aid, and contribution by the central and state government towards schemes for the welfare and benefit of fishermen.

The following section 3.3 discusses the theories relating to the models used in the study.

3.3 Theoretical Base

The theoretical base for purpose of this research is done by using the Cobb Douglas Production Function theory and Alfred Weber's Location theory. The present study examines three different types of fishing crafts, namely; motorised canoes, trawlers and purse-seiners in the study area which follow three different methods of fishing, gill net fishing by motorised canoes, trawling by trawlers and purse-seining by purse-seine fishing vessels. Hence, it is necessary to estimate one production function for each type of fishing craft. The production function estimates information on returns to scale for various methods of fishing. Theoretically, there are three forms of production function viz, Leontief production function, Cobb-Douglas production function and Arrow Chenery Minhas-Solow (ACMS) model. The Leontief production function assumes zero elasticity of substitution, Cobb Douglas production function is based on the assumption of unitary elasticity of substitution. The (ACMS) model assumes elasticity as constant. The constant elasticity of substitution (CES) is however difficult to apply when more than two inputs are used, therefore, the Cobb Douglas production function model is mostly preferred by the economists (Smith, 1982). The Cobb-Douglas function has been widely used by many authors for the empirical analysis on the production function (Seyoum, 1998). Among the three models, Cobb-Douglas production function is used in the present study for empirical analysis. It estimates the relationship between various input factors of production and the output. The production function relates to total product 'P' as a function of labour, capital, land, technology and other inputs and is written as follows;

P = f (Labour, Capital, Land, Technology.......)

In general, production function methods used in analysis are linear, log-linear (Cobb-Douglas, C-D), quadratic, translog (Felipe & Mehta, 2008) and constant elasticity of substitution (CES) (Asamoah, Ewusie Nunoo, Osei-Asare, Addo, & Sumaila, 2012). According to Crentsil and Ukpong (2014), Cobb-Douglas function was assumed as a useful form of production function. This was because it is linear in its logarithmic form, and therefore easy to approximate by using ordinary least squares (OLS) technique. In general, linear regression models cannot be applied directly in fisheries because links between output and inputs need not certainly be linear (Senthiladeban, Rajakumar, & Viswanatha, 2015). Nonetheless, Cobb Douglas production function can be used for such estimation. According to Fredricks, Nair, and J. (1985) catch in marine fishing varies due to the difference in technology, input combinations, fishing resources and technical efficiency. Fishermen will benefit if they are aware of inputs of the factors of production which has significant impact on the output of fish catch. Hence, the Cobb-Douglas production model is the most suitable function which analyses impact of the selected input factors of production influencing output from fish catch in the present study. The other theory, used in this research is the theory of industrial location/geographical by Alfred Weber formulated in 1909 published in 1929, which emphasizes influence of the geographical location of an economic activity based on the least cost principle (Weber, 1929). The location theory assumes that an industry is located where transportation costs of raw material and final product is minimum. This theory is used in the linear regression model to study impact of the districts on net profit, earnings from fish catch and savings from fishing business.

The next section 3.4 explains the data and data sources used in the present study.

3.4 Data and Data Sources

This study uses both primary and secondary sources of data. Primary data is collected through an interview schedule. The time series secondary data during the periods, (1990-2017) is used for computing the trend analysis and Compound Annual Growth Rate (CAGR). The details of data, sources of data and period of study used by the researcher are explained in the foregoing sections.

3.4.1 Period of Study

The period of study is from 1990 to 2017 i.e 27 years, the full period. This period was chosen as it was the liberalization period of the Indian economy. The time series secondary data is taken for the variables, marine and inland fish production, marine exports, primary and Goa's State Domestic Product (GSDP), fishing GSDP from 1990 to 2017. The present study analyzes trends in marine and inland fish production, marine exports and the contribution of primary sector to GSDP as well as fisheries sector to GSDP from 1990-2017.

The next objective was to examine variation in capital investments, costs, earnings and profits of the fishermen owning different categories of traditional motorized canoes and mechanized vessels, both trawlers and purse-seiners in Goa. The traditional motorized canoes and mechanized vessels which were operational and engaged in fishing during the entire fishing season for the period August 2016 to May 2017 in both the districts of Goa were used in the present study. Un-operational fishing crafts were not considered in the present study. Rough conditions of the sea were also considered while determining the time to collect data from the respondents.

The objective related to the role of government support to fishermen in carrying out their fishing business is analyzed through the financial assistance in the form of schemes categorized as subsidies, supplies of material of fishing equipment to the fishermen, grant-in-aid and contribution. Secondary data from (1990-2018) is used for this purpose to analyze the benefit of the schemes. Primary data gathered during (August 2016 to May 2017) is also used to study satisfaction level of fishermen towards the government schemes. It is also used to study satisfaction level of fishermen regarding their economic and social factors affecting their fishing business and problems faced by fishermen in fishing business in both the districts of Goa.

3.4.2 Data Sources and Data Collection

The Gross State Domestic Product (GSDP) of Goa and GSDP of fisheries sector from 1990 to 2017 were obtained from Reserve Bank of India (RBI) website and Statistical Handbook, Government of Goa. Since the base years of GSDP data were changing every four years, the splicing method is adopted to make adjustment of the base year and get one series of GSDP data of Goa taking the base year as 2004-05. Similarly, the FAO year book, Annual Report of DAHD, Annual Report of MPEDA, CMFRI, Goa Economic Survey, Demand book, Government of Goa are also used for collecting secondary data. The study employed primary data for studying commercial and economic aspects of the motorized fishing canoes and mechanized fishing vessels in Goa. The list of fishermen owning motorized canoes and mechanized vessels along with the type of craft owned in both the districts of Goa were identified with the help of data obtained from the Fisheries Department, Government of Goa, the President of Fishermen Association and the Chairmen of Fishermen Co-operatives societies. Empirical data for the study is collected by the researcher through field survey, visits at the fishing ramps and jetties as well as interactions with fishermen in Goa, who are above the age group of 18 years owning registered motorized canoes and mechanized vessels. Some fishermen were contacted and also interviewed at their residence. The cross-sectional primary data is collected by means of a pre-tested structured interview schedule administered to fishermen owning motorized canoes and mechanized fishing vessels (trawlers and purse-seine) in Goa. The main purpose of collecting the primary data is to elicit an understanding of the capital investments, costs and earnings of fishing canoes and mechanized vessels in Goa. The fisheries surveyor at each taluka and in each village were consulted to collect information regarding fishing operations carried out by fishermen in order to cross verify the data. Visits were also made to respective ramps to verify the fish catch on a daily basis during the period of study.

Classification of the motorized canoes is given in chapter five, and mechanized vessels namely; trawlers in chapter six and purse-seiners in chapter seven respectively. Since the study focused on the government support involved in the fishery sector, the respondents who were availing subsidy on fuel on motorized canoes and 100% Value Added Tax (VAT) reimbursement on diesel only were contacted. Data of cost of diesel, catch in kgs, number of trips was again verified from office records of the Goa's fishing co-operative societies situated at the four jetties. The months of June and July were not considered for study due to an increase in fishing ban of 61 days implemented on the mechanized vessels on the west coast by the Government of India from 2015 onwards. The Department of Fisheries, Government of Goa, strictly observes the ban on its coast (Government of Goa, 2016). The fishing ban has been operational in Goa since 1995 and has been strictly adhered by the fishermen owning mechanized vessels.

3.5 Sampling Design

The sampling design includes the population, description of the study area, sampling technique, sample size, pilot study, data collection instrument, content validity and reliability of the interview schedules.

3.5.1 Population

The study is conducted among the population of 1873 operational fishing crafts in the Goan seas, which consisted of 1110 motorized canoes, 462 trawlers and 301 purse-seine fishing vessels. Data is collected from the fishermen owning these fishing crafts in the two districts namely; North and South Goa.

3.5.2 Description of the Study Area

The state of Goa constitutes the universe for this study. There are six talukas in the North and six in South Goa. There are five jetties in Goa namely; Malim, Chapora, in Bardez taluka in North Goa and Vasco locally known as (*Khariwada)* in Mormugao taluka, Cutbona in Salcete taluka and Talpona in Canacona taluka in South Goa. The Department of Fisheries in Goa classifies, Malim, Vasco (*Khariwada)* and Cutbona as major fishing jetties, however mechanized fishing operations are concentrated only on four jetties namely; Malim, Chapora, Vasco and Cutbona. Cutbona is the biggest jetty followed by Malim and Vasco, whereas Chapora and Talpona are the smaller jetties. The sample covers the two districts of Goa namely; North and South Goa. The study covers business of motorized canoes and mechanized fishing vessels (trawlers and purse-seiners) in both rural and urban areas of Goa. For the purpose of this study, researcher has selected fishermen from six coastal talukas namely; Tiswadi, Bardez, Pernem, Mormugao, Salcete, and Canacona owning motorized canoes; and the fishermen from three talukas namely; Bardez, Mormugao, Salcete, owning mechanized vessels. The researcher has chosen the four jetties for the present study, namely; Malim, Chapora, Vasco, Cutbona and Talpona jetty has been excluded as it has only two operational mechanized trawlers hence, not considered as a part of the sample. These six talukas and jetties were selected because motorized canoes, trawlers and purse-seine vessels are concentrated and operational in these talukas and jetties.

3.5.3 Sampling Technique and Sample Size

The sample respondents (fishermen) owning fishing crafts in each taluka have been selected by using systematic random sampling technique on the basis of type of fishing crafts used. Motorized canoes and mechanized vessels being operational in Goa are the primary and ultimate fishing units of the sample. Sample size has been scientifically calculated by the researcher using the Priscilla Salant and Don A. Dillman method (Salant & Dillman, 2007). A brief description of the above method used to select the sample size is given in table 3.1 and equation 3.4. The sample size

Table 3.1 Priscilla Salant and Don A. Dillman Method to Determine Sample Size

Split- Population	**± 3% Sampling error**		**± 5% Sampling error**		**± 10% Sampling error**	
	50/50 split	**80/20 split**	**50/50 split**	**80/20 split**	**50/50 split**	**80/20 split**
100	92	87	80	71	49	38
250	203	183	152	124	70	49
750	441	358	254	185	85	57
1,000	516	406	278	198	88	58
5,000	880	601	357	234	94	61
10,000	964	639	370	240	95	61
25,000	1,023	665	378	234	96	61
100,000	1,056	678	383	245	96	61
1,000,000	1,066	682	384	246	96	61
100,000,000	1,067	683	384	246	96	61

selected in the present study is a true representative of the population. Dillman (2007) gives the following formula for estimating desired sample size given in equation 3.4.

$$Ns = \frac{(N_p)\ (p)\ (1-p)}{(N_p-1)(B/C)^2 + (p)\ (1-p)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(3.4)}$$

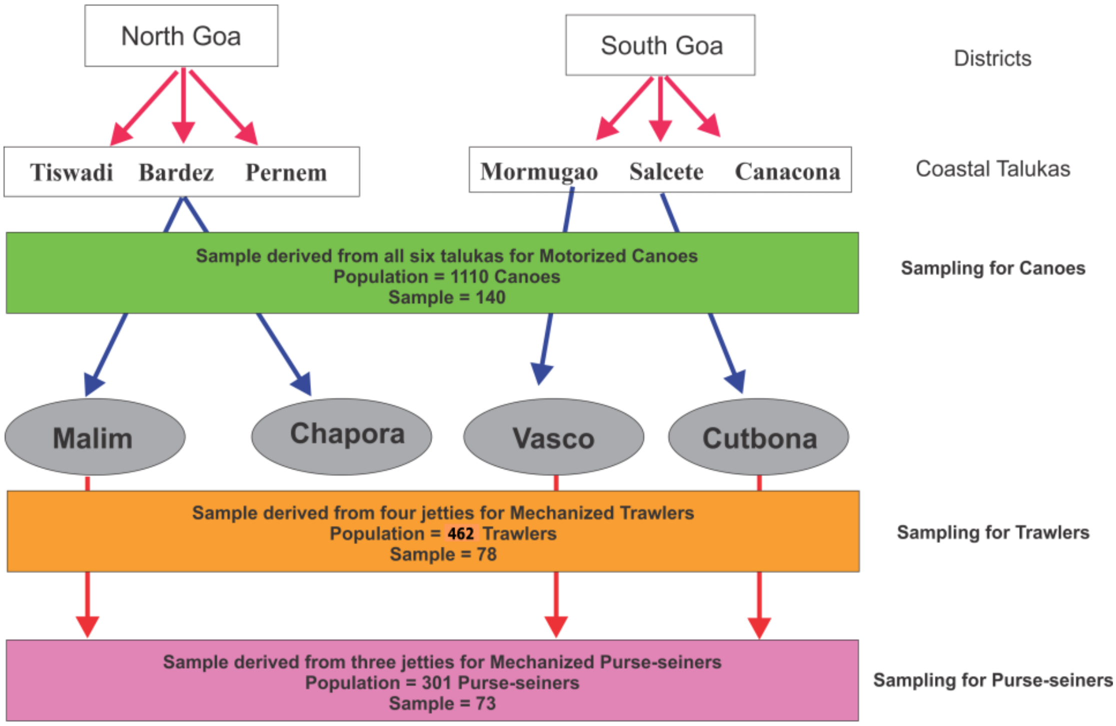
Where: $N_s =$ completed sample size needed (notation often used is n)

$N_p =$ size of population (notation often used is N)

p= proportion expected to answer a certain way (50% or 0.5 is most conservative)
B= acceptable level of sampling error (0.05= ± 5%; 0.03= ± 3%)
C= Z statistic associate with confidence interval (1.645= 90% confidence level; 1.960= 95% confidence level; 2.576= 99% confidence level).

Sample size of motorized canoes and mechanized vessels are selected based on the overall length of the boat i.e. according to the size in feet, horsepower of the fishing craft, number of fishing days, method of fishing and number of labourers employed on these crafts. As per table 3.1, the sample size with 50/50 split, means the population is relatively varied and "80/20" split means the population is less varied. The sampling process is given in figure 3.1.

Figure 3.1 Sampling Process



Source: Researchers compilation from primary survey.

Primary data is collected by means of a structured interview schedule administered to a total of 291 fishermen owning motorized canoes and mechanized vessels, comprising of 140 motorized canoes, 78 trawlers and 73 purse-seine vessels in Goa as shown in sampling process, figure 3.1. The calculation of the sample size of respondents, who are the owners of motorized canoes, trawlers and purse-seiners is also explained in the chapters, five, six and seven respectively. As per Figure 3.1, researcher has selected at random a sample of 140 fishermen owning motorized canoes from the six talukas namely, Tiswadi, Bardez and Pernem in North Goa and Mormugao, Salcete and Canacona in South Goa. Regarding trawling, a sample of 78 fishermen owning mechanized trawlers are selected at random from four jetties, namely; Malim, Chapora, Vasco and Cutbona. As regards purse-seine fishing, a sample of 73 fishermen owning purse-seine vessels are selected at random from Malim, Vasco, and Cutbona jetties. Trawlers operate only from Malim, Chapora, Vasco, Cutbona and Talpona jetties. The trawlers are concentrated in Malim, followed by Vasco, Cutbona and Chapora jetties respectively. Purse-seine vessels operate only from Malim, Vasco, and Cutbona jetties. The purse-seine vessels are concentrated in Cutbona, followed by Malim and Vasco jetties. Chapora jetty does not have purse-seine vessels. As many as 320 respondents were interviewed, but only data from 291 is considered for the analysis, as the 29 interview schedules had to be rejected as the respondents declined to give the relevant information and as such the response sheets could not be completed. Moreover, the researcher encountered difficulty in getting the respondents as some of the fishermen owning canoes, trawlers and purse-seine vessels join the fishing expedition and are not available during the day.

3.5.4 Pilot Study

An interview schedule was designed and first tested through a pilot study by interviewing fishermen owning 40 motorized canoes and 40 mechanized vessels in four talukas, namely, Tiswadi, Bardez, Mormugao and Salcete from March-May 2016. The interview schedule consisted of open and closed ended questions as well as the 5 point likert scale.

3.5.5 Data Collection Instrument

Based on the pilot study, modifications were made in the interview schedules by interacting with experienced fishermen, fisheries experts, chairmen of various fisheries associations, co-operative societies, and authorities from the Fisheries Department, regarding the rules and regulations of the government to be adhered to by the fishermen in Goa. The final interview schedules were revised and restructured to meet the objectives of this study. Primary data is collected based on the final interview schedules prepared using open and close ended questions and also 5 point likert scale. The schedule consisted of nine sections given in the table 3.2. There were three final interview schedules viz. Schedule I for fishermen owning motorized canoes, Schedule II for fishermen owning mechanized trawlers and Schedule III for fishermen owning mechanized purse-seine vessels in Goa. The objectives of the study were explained to sample respondents so as to get accurate and adequate information pertaining to questions in the study. Opinions of the respondents were gathered on 5 point likert scale and weights were assigned to the opinions for satisfaction level and

Table 3.2 Information related to Various Sections and Questions in the Interview Schedules

Sections	Particulars	Canoes	Trawlers	Purse-seines
Section A	Information about the socio-economic characteristics of fishermen	13	13	13
Section B	Characteristics and capital investment in fishing crafts	4	6	6
Section C	Information of labour employed on fishing crafts	4	4	4
Section D	Details of marketing of fish catch	2	2	2
Section E	Particulars of Fixed costs of fishing crafts	4	6	6
Section F	Operating costs of fishing crafts	9	9	9
Section G	Sources of finance and government support in the form of schemes to the fishermen	7	7	7
Section H	Facilities by fishermen association/ co-operative societies	3	10	10
Section I	a. Satisfaction level of fishermen towards schemes	8	8	8
	b. Satisfaction level of fishermen in fishing business	5	5	5
Section J	a. Problems faced by fishermen in fishing business	11	11	11
	Total number of questions in the schedules	**70**	**81**	**81**

Note: Fishermen association is for canoes and fisheries co-operative societies are for trawlers and purse-seine fishing crafts, **Source:** Researchers compilation.

perception on a scale as follows: 1-Very dissatisfied, 2-Dissatisfied, 3-Unsure, 4-Satisfied, 5-Very satisfied and for perception the weights assigned were 1-Strongly disagree, 2-Disagree, 3-Unsure, 4-Agree, 5-Strongly agree. The interview schedules are given in the Annexures I, II, and III respectively.

3.5.6 Test of Content Validity and Reliability

The interview schedules were subjected to content validity. Content Validity Index (CVI) is calculated to assess the necessity and relevance of a question. The interview schedules were evaluated by six experts, three academicians from the commerce field and other three experts from the fisheries sector. Researcher also consulted senior and experienced fishermen familiar with the fishing business. The three factors used for content validity were relevance, clarity and simplicity of the questions (Horgas, Yoon, Nichols, & Marsiske, 2008). On the basis of the scores given by the experts some questions were dropped and some were reframed. The table no 3.3 shows the list of questions dropped and reframed based on the Content Validity Index.

Table 3.3 Content Validity Index Score of the Interview Schedules

Interview Schedules	Q. No	Construct No	Relevancy (Score)	Clarity (Score)	Simplicity (Score)	Result
For Motorized Canoe Owners	A- 12		83.33	33.33	33.33	Changed
Do	C-21		33.33	83.33	33.33	Changed
Do	C-22		83.33	33.33	33.33	Changed
Do	G-26	5	33.33	66.67	33.33	Dropped
Do	G-29		33.33	66.67	33.33	Dropped
Do	G-34	3	50	66.67	33.33	Dropped
Do	G-34	7	33.33	33.33	66.67	Dropped
Do	G-43	10	50	66.67	33.33	Dropped
For Trawler Owners	B-17		83.33	33.33	33.33	Changed
Do	B-19		83.33	33.33	33.33	Changed
Do	C-23		83.33	33.33	33.33	Changed
Do	F-27	3	33.33	83.33	33.33	Changed
Do	G-35	6	33.33	33.33	66.67	Dropped
For Purse-seine Owners	B-17		83.33	33.33	33.33	Changed
Do	G-33	3	33.33	33.33	66.67	Dropped

Source: Researchers compilation based on experts ranking in the interview schedule, Q.No is Question number.

Reliability of the data collected on Likert's Five Point Scale in the interview schedules is checked using Cronbach's Alpha reliability coefficient. As per literature, Cronbach's Alpha reliability coefficient ranges from 0 to 1. When reliability coefficient is 0.7 or greater than 0.7 it is concluded that data collected by the researcher is reliable and can be used for further analysis. Interview schedules administrated to 40 respondents under pilot study is tested for reliability of items under various independent variables. All components in the pilot survey had a Cronbach alpha value of 0.8 and above. Hence, all items under various categories were retained in the final interview schedules. Cronbach's Alpha reliability coefficient has been calculated for total respondents (fishermen) (n=291) for all 42 questions under rating scale in the respondents response for various categories in final interview schedules. Cronbach's Alpha value is presented in the following table 3.4.

Table 3.4 Cronbach's Alpha Reliability Coefficient Value

Questions assessed:	Total respondents (N=291)
Satisfaction level of fishermen on fuel subsidy	0.75
Satisfaction level of fishermen on other government schemes	0.72
Benefits availed by fishermen from fishermen cooperative societies	0.86
Satisfaction level with the fishing business	0.73
Problems faced by the fishermen in fishing business	0.77
Overall Score	**0.77**

Source: Researchers compilation from the data analysis

Table 3.4 shows that the Cronbach alpha reliability coefficient value is greater than 0.77 and hence the data collected by the researcher is used for different statistical analysis as per the objectives framed in present study.

Variables used in the study for all the three objectives are explained in section 3.6.

3.6 Variables used in the Study

The trends, CAGR, Coppock Instability Index and Coefficient of Variation are analyzed by using variables, namely; marine and inland fish production, marine exports, at global, national and state level. The percentage analysis and CAGR is examined by using the variables GSDP of primary sector, fisheries sector and GSDP of the state of Goa. The trends and CAGR is also analyzed by considering variables, namely; marine species of fish in Goa and also jetty-wise fish catch in Goa.

Variables used to study economic and commercial aspects of motorized canoes and mechanized fishing vessels are given in table 3.5. As per table 3.5, gross profit and net profit earned by respondents are computed on the basis of variables such as fishing trips, fishing days, fishing hours, operating and fixed costs and earnings. Another important source of information is the log book maintained by fishermen as per government regulations, and which contains information on the number of trips, number of days of fishing trips, quantity of species of fish caught, and fuel consumption in litres.

Government support to fishermen is analyzed by using the variables namely; schemes and satisfaction level of the fishermen towards availed schemes. Other variables used are problems faced by fishermen in fishing business, satisfaction level with present fishing business and facilities availed by fishermen owning mechanized vessels from the fisheries co-operative societies.

Table 3.5 Variables, Source and Method of Data Collection

Sr. No	Variables used	Source	Method of data collection
1	Quantity of fish catch in kgs and number of fishing trips	Log books	Respondents as well as officials of fishermen's associations/ co-operatives societies at landing centers
2	Expenditure on fuel	Log books	Respondents as well as officials of co-operatives societies
3	Fishing days, fishing hours, capital investments in craft, operating costs, fixed costs, characteristics of fishing vessels, income from one craft, more than one craft, and information on labour	Interview schedules	Respondents
4	Socio-economic characteristics, of respondents, liabilities from fishing and household expenditure per annum	Interview schedules	Respondents
5	Price of the different species of fish catch	Interview schedules	Respondents, observation method and discussion with fish trade agents

Source: Researchers compilation from the primary survey.

Multiple regression model is used to study impact of socio-economic characteristics of fishermen owning motorized canoes and mechanized vessels, on the net profit, earnings from fish catch and savings from fishing business. The basis of assumptions is theoretical considerations found in the literature. Independent variables viz. socio-economic characteristics of the fishermen are as follows:

i. *Gender*: Fishing is a male dominated business and strenuous activity, where male respondents are in a better position to handle the business successfully. Gender is taken as a dummy variable in which 1 is used for male and 0 for female respondents.

ii. *Caste*: In Goa, there are four sub-categories for caste. They are Scheduled Caste (SC), Scheduled Tribe (ST), Other Backward Class (OBC) and General Categories. Caste is taken as a variable since fishing is a caste bound occupation. The OBC category respondents are traditional fishermen whose ancestors have been doing fishing business for generations over the years. They have fishing skills, knowledge of various type of fishing gears used to catch different species of fish and are efficient to easily identify the fishing grounds to catch fish. Respondents owning motorised canoes and mechanised vessels belonged to the OBC and general category. ST respondents were owning motorised canoes. However, there were no respondents belonging to the SC category owning fishing crafts.

iii. *Educational Qualification*: Studies have found that education is an important socio-economic factor as it helps the fishermen to use new techniques of fishing thereby helping them to increase their income. Literacy and education level of fisherman affects the knowledge level, skill development, exposure to production technology and the marketing practices.

iv. *Size of the family*: This variable has been chosen because size of family members has an impact on net profits, earnings and savings from the fishing business. A study by Arthur, (2005) shows that family size is an important socio-economic indicator as it affects the income, food consumption and socio-economic wellbeing of the households.

v. *Experience in fishing business*: Experience plays a vital role in an efficient utilisation of resources and in getting better output in any venture particularly in fisheries sector as it is the core factor in generating traditional knowledge (Mukesh P Bhendarkar et al., 2017). Experience in fishing business was included as a variable with assumption that fishers might have developed certain skills of fishing techniques over the years. Experienced fishermen are able to easily identify spots or movement of fish in the sea which eventually helps them to increase their gross income.

vi. *Number of family members involved in fishing*: The number of family members involved in fishing has positive impact on net profit, earnings and savings. A study by Bhattacharya (2011) shows that income and number of family members involved in fishing are positivley correlated. An increase in the number of family members involved in fishing activities positively affects the net profit, earnings and savings from fishing business.

vii. *Financial status by poverty line*: In this survey, respondents are categorised based on their financial status as “Above Poverty Line (APL)” and “Below Poverty Line (BPL)”.

The linear regression model is also used by taking the variables, namely; geographic location by districts of the fishermen operating fishing crafts in North and South Goa to study impact of districts on the net profit, earnings and savings from fishing business.

For Cobb Douglas production function model, the log-log model of multiple regression is used to study the impact of the selected input of factors of production on the output of fish catch, by using the following variables.

i. *Experience in fishing*: Experience of fishermen is an important factor in earnings. Fishing communities living in coastal areas engaged in fishing for generations and are extremely skilled. They have the knowledge of fish waves from generation to generation by learning and doing (Kurien 2005).

ii. *Horsepower*: Horsepower of the engine is power of the fishing craft which increases speed of the craft. It is an important factor contributing to earnings from fishing.

iii. *Cost of fishing gear* (net): The length, mesh size, type of net and total amount invested in fishing net are important factors contributing to earnings from the fish catch.

iv. *Wages paid to labour*: Labour is an important factor of production which influences earnings in any industry. Wages paid to labour includes the number of labourers employed in the fishing craft and the amount of wages paid per labour.

v. *Fishing hours*: The number of productive fishing hours per fishing craft is an important factor resulting in earnings of fishermen.

vi. *Fishing trips*: The effort of fishing could be represented by the number of fishing trips per fishing craft for the entire fishing season.

vii. *Fuel cost*: Cost of fuel is an important factor of production in fishing. Investment in fuel is a necessity as it helps the fishing craft to travel longer distance in search of different species of fish catch. The cost of fuel is calculated in this study, after deducting 100% VAT reimbursement/fuel subsidy from the actual amount spent on fuel.

3.7 Hypotheses of the Study

The following hypotheses are framed for the three objectives in the present study from chapter’s four to eight;

Chapter four analyzes the trends in marine and inland fish production, marine exports and their contribution to Goa's State Domestic Product, the hypotheses are as follows:

H01: "*There is no significant growth of the marine species of fish production in quantity in Goa from 1990 to 2017".*

H02: "*There is no significant growth of marine exports, marine production, and marine exports of Goa to production ratio in terms of quantity from 1990 to 2017".*

Chapter five to seven examines the variation in capital investments, costs, earnings and profits of the fishermen owning different categories of traditional motorized canoes and mechanized vessels (trawlers and purse-seiners), the hypotheses are given below:

H01: *"There is no significant difference between the mean of the variables, net profit of single fishing craft, more than one fishing craft, savings from fishing, liabilities, and the household expenditure of the fishermen owning motorized canoes, trawlers and purse-seine vessels among the two districts in Goa"*.

H02: "*Across size of motorized canoes, trawlers and purse-seine vessels, there is no significant difference between the mean of the variables, capital investments in fixed assets, fixed costs, operating costs among districts for motorized canoes, and jetties for trawlers and purse-seine fishing vessels".*

H03: "*Across size of motorized canoes, trawlers and purse-seine vessels, there is no significant relation between the mean of the variables, fishing trips, fishing days, and fishing hours for entire fishing season from August to May among districts for motorized canoes and jetties for trawlers and purse-seine fishing vessels".*

H04: "*Across size of motorized canoes, trawlers and purse-seine vessels, there is no significant difference between the total costs, catch, gross revenue and profits per trip among districts for motorized fishing canoes, and jetties for trawlers and purse-seine fishing vessels".*

H05: *"Socio-economic characteristics of the fishermen owning motorized canoes, trawlers and purse-seine vessels have no impact on the net profits, earnings from fish catch and savings from the fishing business"*.

It is assumed that following variables, namely; gender, caste, educational qualification, experience in fishing business, number of family members involved in fishing, financial status by poverty line has a positive relation with net profit, earnings and savings from the fishing business, whereas size of family negatively influences the net profits, earnings and savings from fishing business.

For the linear regression model, hypothesis is based on the theory of industrial location by Alfred Weber (1909). Based on the location theory, it is hypothesized that "*A positive relation exists between the districts and the net profit, earnings from fish catch and savings from the fishing business".*

H06: "*Geographic location (by districts) of the fishermen has no impact on the net profit, catch and savings of motorized canoes, trawlers and purse-seine fishing vessels in Goa".*

Based on the Cobb Douglas production function theory it is hypothesized that, H07: "*There is no impact of selected input of factors of production on the output of fish catch i.e earnings from motorized canoes, trawlers and purse-seine fishing vessels in Goa".* It is hypothesized that the variables, namely, experience of fishermen, cost of fishing gear, wages paid to the labour, fishing hours, fishing trips and cost of fuel has a positive relationship on the earnings from the fish catch.

H08: *"There is no significant difference between the economic and financial indicators in terms of ratios among the different sizes of motorized canoes, trawlers and purse-seine fishing vessels in Goa".*

Chapter eight studies the role of Government with respect to financial assistance in the form of schemes provided to the fishermen owning traditional motorized canoes and mechanized vessels in Goa, the hypotheses are given below:

H01: "*There is no impact of fuel subsidies on the satisfaction level of fishermen".*

H02: "*The satisfaction level of the fishermen is not dependent on the supplies of material and the subsidies they receive from government in carrying out their fishing business*".

H03: "*There is no significant difference in the satisfaction level of the fishermen owning mechanised vessels in North Goa and South Goa regarding the facilities availed by them from fisheries cooperative societies*".

H04: "*There is no significant difference in the satisfaction level of fishermen on the economic and social factors in the fishing business in North and South Goa*".

H05: "*There is no significant difference in the problems faced by the fishermen between the two districts i.e North and South Goa"*.

All the variables used in the study are of ratio, ordinal, and nominal scales.

Section 3.8 explains the statistical and econometric tools used for the purpose of data analysis in the present study.

3.8 Statistical and Econometric Tools for Data Analysis

The statistical and econometric tools used for data analysis is explained in the section 3.8.1 to 3.8.7 respectively. Statistical tools include namely, Descriptive statistics, Parametric, Non-parametric tests, Trend analysis, CAGR, Coppock Instability Index and Coefficient of Variation. The econometric tools include the semi-log regression model, multiple regression and log-log model of multiple regression. Primary and secondary data is analyzed using MS Excel and SPSS version 21. The significance level considered for this study is 1%, 5%, and 10 % respectively.

3.8.1 Descriptive Analysis

Researcher has used analytical techniques for data analysis such as descriptive statistics, frequency, percentage analysis, mean and inferential statistics, for all the three objectives.

3.8.2 Parametric tests

The parametric tests used for data analysis are namely, independent sample *t*-test, one way ANOVA and post hoc test.

3.8.2.1 Independent Sample *t* test

This test is used to compare the means of two samples. In the present study, independent sample *t*-test is used to compare the mean of variables, capital investments, operating and fixed costs, and economic indicators such as gross earnings, gross and net profit across the size of the motorized canoes and purse-seine vessels. The same *t*-test and variables are also used across the districts for motorized canoes and across the jetties for the purse-seine vessels. This test is also used to compare the satisfaction level of fishermen regarding the schemes availed by them, satisfaction level over social and economic factors affecting their fishing business in both the districts. The *t*-test is also used to compare problems faced by fishermen in both the districts.

3.8.2.2 Analysis of Variance (ANOVA)

It is a parametric test used to compare the means of two or more samples. One way ANOVA test is used to compare the mean of the variables, capital investments, operating and fixed costs, economic indicators across the size of trawlers and across the jetties. Same variables are also used to compare purse-seine vessels across jetties using one way ANOVA test.

3.8.3 Non-Parametric tests

These tests are used with populations that are neither normally distributed nor based on continuous data and considers how to conduct statistical tests if the assumption of normality is violated. Following are the non-parametric tests:

3.8.3.1 Mann-Whitney U test

It is the non-parametric alternative test to the independent sample *t-test*. It is used to compare two sample means that come from the same population, to test whether two sample means are equal or not. This test is used to compare the ratios of economic indicators in case of motorized canoes and purse-seine vessels.

3.8.3.2 Kruskal-Wallis H test

It is (also called as "one-way ANOVA on ranks") a rank-based non-parametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. This test is used to compare the ratios of economic indicators of trawlers.

3.8.3.3 Friedman's test

It is a non-parametric test, alternative to ANOVA and is used to test differences between groups when the dependent variable is measured on ordinal scale. Friedman's test is used for mean ranking of the variables used in the present study. It is used to rank the satisfaction level of fishermen in terms of schemes availed by them from the government. This test is used to rank satisfaction level of the fishermen owning mechanized vessels regarding facilities availed by them from the fisheries co-operative societies. This test also is used to rank the perception of the fishermen regarding severity of the problems faced by them in fishing business.

3.8.3.4 Fishers Exact test and Chi-square tests

The fisher's exact test of significance is used in the analysis of contingency tables. It is a one tailed tests. This test is applied to test the hypothesis with regard to the satisfaction level of the fishermen pertaining to the subsidies availed by them.

The contribution of fishing industry to Goa's economy is analyzed by examining the trends in fish production (marine and inland) and marine exports by using the following techniques, namely; trend analysis, compounded annual growth rate (CAGR), Coppock instability index and Coefficient of Variation which are explained in sections 3.8.4 to 3.8.6 respectively.

3.8.4 Trend Analysis

The concept of comparing data over a particular period of time to identify any consistent results or trends is called trend analysis. Trend analysis is utilized in identifying either positive or negative alterations or movements in the data in numerous areas. Mohanty (2013) used trend analysis to analyse the trends in marine and inland fish production in India. Further, a study by Waghmode (2016) used trend analysis for the analysis of marine exports of India. The present study uses trend analysis to examine comparative trends in terms of quantity of marine and inland fish production at global, national and state level through sub-period average of relative percentages from 1990 to 2017. Similarly, comparative trends in the quantity of marine exports at the global, national and state level is examined through percentage analysis from 1990 to 2017. The present study uses average and percentage analysis to study the contribution of fishing industry to Goa's economy from 1990 to 2017.

3.8.5 Compounded Annual Growth Rate (CAGR)

Compounded Annual Growth rate (CAGR) is generally utilized in business for investigating a particular period for the smoothed yearly profit of an investment over a particular period of time (Investopedia, 2018). CAGR is used to measure the growth over multiple time periods in any sector. It is also used in fisheries sector to measure growth rate for fish production and exports. The formula for calculating CAGR is as follows:

$$CAGR(t_o, t_n) = \left(\frac{V(t_n)}{V(t_o)} \right)^{\frac{1}{t_n - t_o}} - 1 \quad \text{...}\textbf{(3.5)}$$

Where, the start value is denoted as $V(t_o)$, the finish value is denoted as $V(t_n)$ and number of years is denoted as $t_n - t_o$.

This study used CAGR method for analyzing the share of growth of Goa's fishing sector to primary sector and share of fishing sector to GSDP (in value terms) for the period 1990 to 2017. CAGR is also used to examine the growth of marine exports to marine production (in quantity) of Goa from 1990 to 2017. CAGR is used to estimate the growth trends in marine exports of Goa (in quantity) to different countries of the world from 1995 to 2017. CAGR is used for marine species-wise production (in quantity) of Goa for the period 1990 to 2017. In order to study the role of Government in promoting the fishing business in Goa, the schemes, namely; (subsidies, supplies of material, grant-in-aid and contribution) provided to fishermen is analyzed using averages and percentage analysis from 2012-2018. CAGR is also used to examine growth of the schemes given to the fishermen in Goa for the period 1990-2018. The calculation of per capita benefit of the schemes availed by fishermen is given in the Chapter 8, (Equation No. 8.1 and 8.2).

3.8.6 Coppock Instability Index and Coefficient of Variation

This technique was devised by Coppock in 1962 (Coppock, 1962). Coppock Instability Index is defined as the trend free measure of variability that is a close approximate of the averages year to year percentage variation adjusted by trend (Singhal & Kaur, 1989). Earlier researchers have used the Coppock instability index and the Coefficient of variation to measure the instability index to evaluate growth performance. It has been used in fisheries to estimate the extent of variability. Coppock's instability index has been used by Dash and Patra (2014) to analyze production of fish growth, to get the close approximation of the average percentage variation (year-to-year) in the value of the variable. Kalidoss et al., (2016) applied Coppock instability index to calculate the extent of variability in marine fish production of Tamil Nadu. The formula of Coppock instability index is given as follows:

Coppock Instability Index = $(Anti \log \sqrt{\log V - 1}) \times 100$ ....**(3.6)**

To calculate log *V*,

$$\text{Log } V = \frac{\left[\frac{\sum \log X_{t+1}}{x_t} - M \right]^2}{N}$$ ....**(3.7)**

Where, X_t is denoted either as production, yield or area and t is denoted as the number of years, M is denoted as mean value of successive difference of log values and Log *V* is denoted as logarithmic variance of the series.

Coefficient of variation (CV) is a measure of variation from the mean. It is the ratio of standard deviation to the mean. Coefficient of variation for a variable *X* that is production, yield or area is calculated by using the formula given in equation 3.8 and 3.9.

$$Coefficient\ of\ Variation = \frac{Standard\ Deviation\ of\ X}{Mean\ of\ X} \times 100$$ ....**(3.8)**

The standard deviation of X is calculated by using the formula:

$$S.D.of\ X = \sqrt{\frac{1}{N}\sum(X - \bar{X})^2}$$ ....**(3.9)**

Where, $\bar{X}$is denoted as the arithmetic mean of *X* and *N* is denoted as the number of observation.

The coefficient of variation is used in the present study to estimate the extent of variability in fish production (marine and inland) and marine exports in terms of quantity at the international, national and state level from 1990-2017. The Coppock instability index is used to measure instability in marine, inland fish production and marine exports of World, country and Goa, in terms of quantity for the period 1990-2017.

3.8.7 Regression Models

The present study uses econometric tools namely, semi-log regression, linear and multiple regression, and log-log models of regression. The ordinary least square method is given in section 3.8.7.1, semi-log regression model in section 3.8.7.2, linear regression in 3.8.7.3, multiple regression in 3.8.7.4, and log-log model of regression in 3.8.7.5 respectively.

3.8.7.1 Ordinary Least Square Models (OLS)

The OLS is a type of linear least square method to estimate the unknown parameter in a linear regression model on the assumption that errors are normally distributed. It is commonly known as linear regression (simple and multiple depending on the number of explanatory variables). The OLS has been estimated for semi-log regression, linear and multiple regression, and log-log models as follows:

3.8.7.2 Semi-log regression models

The semi-log model is used to find the relative change in a given variable over a time. The semi-log regression model is one in which only one variable the regressed the dependent variable (*Y*) appears in the logarithmic form. In the semi-log regression model, natural log values are used for dependent variable (*Y)* and for independent variables (*X*) in their original scale then the econometric specification is called a log-linear model. The semi-log-linear model is typically utilized when the variables might have an exponential growth relationship (Pedace, 2013).

According to Rodríguez-Barranco, Tobías, Redondo, Molina-Portillo, & Sánchez, (2017) , the semi-log model could be written as given in equation 3.10.

$$\textbf{\textit{Log Y}} = \alpha_0 + \beta X_1 + \mu \quad \textbf{(3.10)}$$

In order to compute the CAGR, the semi-log regression model is used. The models are linear in parameters but nonlinear in variables. In a linear model, *Y* is the linear function of the regressors, *X*. This model is like any other linear regression model in that the parameters β_i and β_2 are linear. Regressor is the time which takes the values of 1,2,3, etc. as given in equation 3.11.

$$\textbf{\textit{Log}}\ Y_t = \alpha_0 + \beta_i X_t + \mu \quad \textbf{(3.11)}$$

β_i is the intercept and is constant term. The coefficient of the trend variable in the growth model, β_2 gives instantaneous rate of growth at a point in time and not the compound rate of growth. If we multiply the relative change in *Y* by 100 it will give percentage change, or the growth rate, in *Y* for an absolute change in *X*, the regressor. Thus 100 times β_2 gives the growth rate in *Y*; 100 times is also known as semi-elasticity of *Y* with respect of *X*. The coefficient of the trend variable β_2 in the growth equation 3.6, gives the instantaneous rate of growth at a point of time and the compound rate of growth (CAGR) is calculated can be found by taking the antilog of the estimated $\beta_{2,}$ and subtracting it from 1 and multiplying the difference by 100 as given in 3.12

Compound Growth Rate= {(Antilog β_2 - 1)} x 100……………………………**(3.12)**

This study uses the semi-log regression model to compute the growth of primary sector to GSDP, fishing to primary sector and fishing to GSDP of Goa (in value) from 1990 to 2017. The semi-log regression model is also used to estimate the growth for different species-wise marine fish production, ratio of marine exports to production in terms of quantity in Goa for the period 1990 to 2017. It is also used to estimate destination wise marine exports from Goa to different countries from 1995 to 2017. The ranking method is used to analyze destination-wise marine exports from Goa to different countries of the world in terms of quantity from 1995 to 2017.

3.8.7.3 Linear Regression

Simple linear regression finds the relationship between two continuous quantitative variables. In simple linear regression, there is one independent variable (X) which predicts dependent variable (Y). In the present study, the linear regression model is used to study impact of geographic location (by district) of the fishermen operating fishing crafts in both the districts on net profit, earnings and savings from fishing business. The independent variable chosen is the Districts. The dependent variables are as follows: Y_1 denotes net profit, Y_2 denotes earnings from fish catch and Y_3 denotes savings from fishing business. The independent variable is X_1 which denotes the Districts (Dummy variable, South Goa =1 and North Goa =0) in case of fishermen owning motorized canoes and purse-seine vessels and District (Dummy variable, North Goa =1 and South Goa =0) in case of fishermen owning trawlers in Goa, and u_i is the residual error term assumed to have a zero mean and constant variance. The equations are given in 3.13, 3.14 and 3.15 respectively.

$Y_1=\alpha_0+\beta_1X_1 + u_i$…………………………………………………………..........................**(3.13)**

For equation (4) to capture the influence on Y_1

$Y_2= \alpha_0+\beta_1X_1+u_i$……………………………………………………………………… **(3.14)**

For equation (5) to capture the influence on $\boldsymbol{Y_2}$

$\boldsymbol{Y_3 = \alpha_0 + \beta_1 X_1 + u_i}$……………………………………………………………………………**(3.15)**

For equation (6) to capture the influence on $\boldsymbol{Y_3}$

Where it is expected that $X_1 \geq 0$, with respect to net profit given in equation…... **(3.13)**

Where it is expected that $X_1 \geq 0$, with respect to earnings given in equation…... **(3.14)**

Where it is expected that $X_1 \geq 0$, with respect to savings from fishing business given in equation ……………………………………………………………………… **(3.15)**

3.8.7.4 Multiple Regression

Multiple regression is an extension of simple linear regression and the term was first used by Pearson (1908). It is a statistical tool under (OLS) method and is used for prediction of unknown value of a variable from two or more known variables. It is used to assess the relationship between one quantitative dependent (criterion) variable and multiple independent (predictor) variables. The equation for multiple regression is given in equation 3.16.

$\boldsymbol{Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + u_i}$ ………………………………………………………… **(3.16)**

Where, '$\boldsymbol{Y}$' is denoted as a predicted value of $\boldsymbol{Y}$ that is the dependent variable, '$\boldsymbol{\alpha_0}$' is denoted as the '$\boldsymbol{Y}$ Intercept', '$\boldsymbol{\beta_1}$' is denoted as the change in $\boldsymbol{Y}$ for every 1 increment change in $\boldsymbol{X_1}$, '$\boldsymbol{\beta_2}$' is denoted as the change in $\boldsymbol{Y}$ for every 1 increment change in $\boldsymbol{X_2}$ and $\boldsymbol{u_i}$ ***is*** the residual error term assumed to have a zero mean and constant variance.

Several indicators have been used by earlier researchers to study the impact of socio-economic factors on income from fishing activities. Socio-economic factors play a significant role in using various resources to improve economic status of the fishermen. Awoyemi (2011) used multiple regression model to determine the influence of socio-economic factors on fish output level. Bhendarkar et al. (2017) examined livelihood status of fishermen in Kabirdham district by examining the socio-demographic condition such as religion, caste, age, family size, education level, type of family, housing condition and the income of fishers. Oluwasola & Ige, (2015) employed multiple regression model to determine influence of socio-economic factors on the fish output level.

Assumptions considered in this study are based on a theoretical framework which is found in the review of literature. A multiple regression model is estimated for this purpose; the study assumes that variables, such as socio-economic characteristics of fishermen have an impact on net profit, earnings from fish catch and savings from the fishing business. The dependent variables used for multiple regression models are net profit, earnings from fish catch, and savings of fishermen from fishing business for the entire fishing season that is August 2016 to May 2017. Independent variables used for multiple regression model are socio-economic characteristics of fishermen owning motorized canoes and mechanized vessels.

The multiple linear regression model is chosen to study impact of independent variables on the dependent variables using three different equations.

The three multiple regression equations are specified as follows:-

$$Y_1=\alpha_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+u_i \ldots\ldots\ldots\ldots (3.17)$$

For equation (1) to capture the influence on Y_1

$$Y_2=\alpha_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+u_i \ldots\ldots\ldots\ldots (3.18)$$

For equation (2) to capture the influence on Y_2

$$Y_3=\alpha_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+u_i \ldots\ldots\ldots\ldots (3.19)$$

For equation (3) to capture the influence on Y_3

Where it is expected that $X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$, $X_4 \leq 0$, $X_5 \geq 0$, $X_6 \geq 0$, $X_7 \geq 0$, with respect to net profit given in equation …………………………………………………….….... (**3.17**)

$X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$, $X_4 \leq 0$, $X_5 \geq 0$, $X_6 \geq 0$, $X_7 \geq 0$, with respect to earnings given in equation ……………………………………….……………………………..………………(**3.18**)

and $X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$, $X_4 \leq 0$, $X_5 \geq 0$, $X_6 \geq 0$, $X_7 \geq 0$ with respect to savings from fishing business given in equation………………………………………..……….............(**3.19**)

Y_1 is the dependent variable and denotes net profit, Y_2 is the gross value of earnings from fish catch and Y_3 is savings from fishing business per annum.

Independent variables chosen are as follows: X_1= Gender of the respondents (Dummy variable, male=1 and female= 0), X_2 = Caste of the respondents, two dummy variables were created for ST and OBC, OBC as 1 and General category as 0, X_3=Educational qualification of the respondents (in years), X_4= Size of the family (number), X_5= Experience in fishing business (in years), X_6=Number of family members involved in fishing (number). X_7= Financial status by poverty line of the respondents (Dummy variable Above Poverty Line=1, and Below Poverty Line=0), u_i is the residual error term assumed to have a zero mean and constant variance.

The following section 3.8.7.5, explains the Cobb Douglas production function used in the present study to examine relationship between the selected input of factors of production and the resultant level of output.

3.8.7.5 The Cobb Douglas Production Function Model

Linear production function assumes a linear relationship between dependent and independent variables. The Cobb Douglas production function theory is used to study the impact of the input of factors of production of fishing affecting the output from fish catch i.e earnings from the fishing activities. The linear and Cobb-Douglas (log-log) production functions were estimated using ordinary least square method. Once a log-log model is being estimated, coefficients could be utilized in determining the impact of independent variables (*X*) on the dependent variable (*Y*). The coefficients in a log-log model are represented as elasticity of *Y* variable with respect to *X* variable. An estimated percentage change in the coefficient of dependent variable will lead to percentage change in the independent variable (Pedace, 2013). In a simple log-log model, coefficients could be interpreted as follows in equation 3.20.

$$\text{Log}(Y) = \alpha_0 + \beta_1 \log(X_1) + \beta_2 \log(X_2) + u_i \quad \text{......} \quad (3.20)$$

To study production function of the three different types of fishing crafts namely; motorized canoes, trawlers and purse-seine vessels, the Cobb Douglas production function theory is used to estimate relationship between selected input of factors of production and output from fish catch. The production function highlights comparative economic efficiencies of three different types of fishing crafts operating in Goa. In the present study, the log-log form of multiple regression model is used to study impact of selected input of factors of production on earnings from fish catch. This study makes an attempt using the Cobb Douglas production function theory to identify whether the selected input factors of production, i.e the independent variables namely; experience of respondents, horse power of fishing craft, total cost of fishing gears, total wages paid to labourers, cost of fuel, total number of fishing hours and fishing trips have any impact on dependent variable, the output of fish catch viz. earnings. A specific form of multiple regression, log-log model is used to assess the relation between factors of production and earnings of the fishermen in Goa given in equation 3.21. The model is given as:

$$\mathbf{Log}\boldsymbol{Y}= \boldsymbol{\alpha_0}+\boldsymbol{\beta_1}\mathbf{log}\boldsymbol{X_1}+\boldsymbol{\beta_2}\mathbf{log}\ \boldsymbol{X_2}+\boldsymbol{\beta_3}\mathbf{log}\boldsymbol{X_3}+\boldsymbol{\beta_4}\mathbf{log}\boldsymbol{X_4}+\boldsymbol{\beta_5}\ \mathbf{log}\boldsymbol{X_5}+\boldsymbol{\beta_6}\ \mathbf{log}\boldsymbol{X_6}+\boldsymbol{\beta_7}\ \mathbf{log}\boldsymbol{X_7}+\boldsymbol{u_i} \quad \ldots\ \mathbf{(3.21)}$$

For equation (3.21) to capture the influence on **Log*Y***

Where it is expected that $X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$, $X_4 \leq 0$, $X_5 \geq 0$, $X_6 \geq 0$, $X_7 \geq 0$ with respect to log of earnings given in equation………………………………………….…..……… **(3.21)**

where ***Y***= Output of fish catch i.e Earnings from fish catch from August to May (in ₹), $\boldsymbol{X_1}$= Experience in fishing (in years), $\boldsymbol{X_2}$= Horse power of boat (in unit), $\boldsymbol{X_3}$= Total cost of fishing gear (in ₹), $\boldsymbol{X_4}$ = Wages of labour for August to May (in ₹), $\boldsymbol{X_5}$ = Total fishing hours for August to May(in number), $\boldsymbol{X_6}$ = Fishing trips for August to May (in number), $\boldsymbol{X_7}$=Fuel cost for August to May (in ₹) and u_1 is the residual error term assumed to have zero mean and constant variance.

In the Cobb Douglas production model in order to find the impact of input of factors of production on earnings, the dependent and independent variables were transformed into log to satisfy the Shapiro test of normality value of more than 0.05. Log was taken for all six independent variables and one dependent variable to maintain uniformity.

Section 3.8.7.6, explains the economic indicators used to compare economic and financial performance of the motorized canoes and mechanized vessels operating in Goa with the help of ratios.

3.8.7.6 Economic Indicators of Fishing Crafts through Ratio Analysis

Ratio analysis is an attempt to derive quantitative measures concerning financial health and profitability of the business enterprise (Chopde and Choudhari, 2007). Through ratio analysis, various economic indicators like input-output efficiency, capital efficiency, profitability ratios, labour efficiency ratios and marginal efficiency are used to analyze economic and financial performance of motorized canoes and mechanized vessels. Non-parametric test, namely; Kruskal-Wallis test, is used to test the hypotheses of economic indicators of different ratios for trawlers. The Man Whitney *U* test is used to test the hypotheses of economic indicators of different ratios for motorized canoes and purse-seine vessels. Key economic indicators as well as some aggregate measures were estimated on the basis of cost and earnings data collected from the respondents to study economic efficiency of traditional and mechanized fishing crafts along the Goan coast.

Previous studies have used various economic indicators to measure economic and financial performance of fishing crafts. Researchers employed economic and financial indicators in their studies such as cost ratios (Mmopelwa, Raletsatsi, & Mosepele, 2005), operating ratio, fixed costs ratio (Reddy, S., Neelakanta Sastry, & Devi, 2004), total costs ratio (Nalatham, 2014), return on investment (Tunde, Mp, Oladipo, & Olasunkanmi, 2015), break even analysis, margin of safety, labour productivity (Gee, Pinello, & Polymeros, 2017). Profit volume ratio (Habeeb, 2012), Payback period (Mohamad Kasim et al., (2013) and (Radhakrishnan et al., 2018), Benefit cost ratio (Gaikwad, 2009). Rate of return, cost benefit ratio (U Tietze, Prado, Le Ry, & Lasch, 2001), net returns (Panikkar, Sehara, & Kanakkan, 1994) and (Mohamad Kasim et al.,2013) capital and labour productivity (Narayanakumar, Sathiadhas, & Aswathy, 2009); (Hassan & Sathiadhas, 2009), capital turnover ratio (Planning Commission, 2013), and (Aswathy, Shanmugam, and Sathiadhas, 2011).

Ratios are indicators of the proportion of gross benefit derived and are used to meet different types of expenses in fishing activity (Reddy et. al., 2004)**.** These various indicators like input-output efficiency, capital efficiency, profitability ratios, labour productivity (efficiency) ratios and marginal costing are used to compare economic and financial performance of motorized canoes and mechanized vessels on the basis of their costs and return. Input-output efficiency (cost ratios) are used to measure relationship between the amount spent as input and the value realized as output. It explains the value realized from output for spending every rupee as input. It includes operating, fixed cost and total cost ratios. Net operating income (gross profit), net profit, capital and labour productivities were used to measure economic and financial performance assessed through the rate of return on investment. Gross profit ratio, net profit ratio, operating ratio, fixed costs ratio, total costs ratio, capital turnover ratio, expense ratios, labour productivity, capital turnover ratios and payback period were used to compare the economic performance of motorized canoes and mechanized vessels. Economic indicators helps the fishermen owning fishing crafts to decide whether the fixed costs and variable costs incurred in marine fishing activity is exorbitant or economical and whether the return from fish catch i.e gross earnings can cover the costs to sustain in the fishing business. Following economic and financial indicators using ratios are explained in the below given formulae's.

1. *Input-output efficiency* (*Cost ratios*): This ratio measures the relationship between amount spent as input and value realized as output. It includes operating, fixed cost and total cost ratios.

i. *Operating ratio*: This ratio is used to compare economic efficiency of the fleet to cover operating expenses. Higher the operating ratio, lower is capital productivity and lower the operating ratio, better is capital productivity of fishing crafts. Improvement in operating efficiency is directly reflected in this ratio. It shows how much amount was spent by fishermen on operating expenses to generate gross revenue.

$$\text{Operating ratio} = \frac{\text{Operating Expenses}}{\text{Gross Revenue}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(3.22)}$$

ii. *Fixed cost ratio*: Fixed cost ratio is calculated as a percentage of the gross revenue.

$$\text{Fixed cost ratio} = \frac{\text{Fixed cost}}{\text{Gross Revenue}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(3.23)}$$

iii. *Total cost ratio* (gross cost ratio): This ratio expresses the percentage of gross revenue consumed by expenses.

$$\text{Total cost ratio} = \frac{\text{Total cost}}{\text{Gross Revenue}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(3.24)}$$

2. *Capital efficiency*

i. *Capital turnover ratio*: It is used to measure the rate at which gross revenue (earnings) is generated by investing in capital. This ratio is the most common measure of capital efficiency. The rate of capital turnover indicates the number of years required for the receipts from fishing business to equal to the average capital. A faster turnover rate is sign of a good business.

$$\text{Capital turnover ratio} = \frac{\text{Gross Revenue}}{\text{Capital Investment}} \times 100 \ldots\ldots\ldots\ldots \textbf{(3.25)}$$

ii. *Capital investment per labour*: This ratio explains the amount invested in capital per labour.

$$\text{Capital per labour} = \frac{\text{Total capital invested}}{\text{Number of labourers employed}} \ldots\ldots\ldots\ldots(\textbf{3.26})$$

iii. *Payback period* (*in years*): Payback period is the period in which the net profit earned from fishing business is used to repay the capital investment. Lesser number of years taken to recover capital investment higher is the efficiency in terms of payback period of the fishing crafts and vice-versa.

$$\text{Payback period} = \frac{\text{Capital investment}}{\text{Net profit}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.27)}$$

3. *Profitability ratios*: Profitability ratios such as Benefit-Cost Ratio, Return on investment were used by to analyse profitability and viability of fish farming in Nigeria (Tunde et al., 2015).

i. *Benefit Cost Ratio* (BCR): In the present study, financial performance of the fishing crafts is assessed using benefit cost ratio. Benefit cost ratio is a profitability index. It is the ratio of present value of future net cash flows over the life of the project to the net investment. Benefit costs ratio shows how much owner receives from every rupee spent to carry out the fishing activity. The thumb rule is, if the BCR is >1, it indicates the financial viability of investment in fishing business and the fishing activity is profitable. If BCR=1, then the fishing is at breakeven, it means there is neither loss nor profit, If BCR<1, then the project is operating at a loss. If the project value is greater or equal to 1, the profitability index is accepted. Shajeeva, (2016), used benefit cost ratio to study the economics of trawl operations in Thoothukudi in Tamil Nadu.

$$\text{Benefit Cost Ratio} = \frac{\text{Total Gross Revenue}}{\text{Total costs}} \ldots\ldots\ldots\ldots\ldots \textbf{(3.28)}$$

ii. *Gross profit ratio* (GPR): Higher the gross profit ratio, better is the efficiency and vice-versa.

$$\text{Gross profit ratio} = \frac{\text{Gross profit}}{\text{Gross revenue}} \times 100 \ldots\ldots\ldots\ldots \textbf{(3.29)}$$

Gross profit ratio was used by Olagunju, Adesiyan, & Ezekiel, (2007), in Oyo state of Nigeria. Their study finds that gross margin analysis is a good measure of profitability and there is a significant relationship between total revenue and costs involved in fishing activities. The results show that economic feasibility of fishing vessels depends on the returns from fishing, fishing experience, skills of labour, depth of fishing, number of fishing days, fishing trips, fishing hours, diversified fishing gears and technological equipment used. The study concludes that fish production was highly profitable in Nigeria.

iii. *Net profit ratio*: Net profit ratio determines profitability and efficiency of fishing crafts. It indicates the extent to which it will help fishermen to reduce operating and fixed costs. A higher net profit ratio will help the fishermen to run their business efficiently.

$$\text{Net profit} = \frac{\text{Net profit}}{\text{Gross revenue}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(3.30)}$$

Ünal & Franquesa, (2010) used net profit ratio to study economic and financial performance of fishing fleet of small scale fisheries on Turkish coast and finds that a net profit ratio of more than 10 can be considered as good. M. Suresh, (2012), used net profit ratio in the thesis to study the export potential of marine products and its impact on eradication of poverty in Andaman islands.

iv. *Ratio of Return on investment*: The financial performance of all fishing crafts is measured through the rate of return on investment. This ratio shows how much money needs to be invested in fishing unit to generate a certain level of net profit. According to Uwe Tietze (2005), net profit expressed as a percentage of the invested capital indicates the profitability of the investments.

$$\text{Ratio of return on investment} = \frac{\text{Net Profit- Interest on Loan}}{\text{Capital Investment}} \times 100 \quad \ldots\ldots \textbf{(3.31)}$$

<u>Efficiency Ratios</u>

$$\text{Catch per trip (in kgs)} = \frac{\text{Total fish catch for entire season (kgs)}}{\text{Total number of trips}} \quad \ldots\ldots \textbf{(3.32)}$$

$$\text{Labour productivity} = \frac{\text{Fish catch in kgs}}{\text{Number of labourers}} \quad \ldots\ldots \textbf{(3.33)}$$

$$\text{Labour Productivity per man days} = \frac{\text{Gross revenue}}{\text{Number of man days}} \quad \ldots\ldots \textbf{(3.34)}$$

$$\text{Capital per labour} = \frac{\text{Total capital invested}}{\text{Number of labourers employed}} \quad \text{.......(}\mathbf{3.35)}$$

5. *Cost volume profit analysis* (*Marginal Efficiency*)

In marginal costing and conventional economic theory, break-even point (BEP) is a point where total revenue (TR) equals to total cost (TC), (TR=TC), hence no profit is made and neither losses are incurred. TR is total revenue received from the sale of fish catch and TC represents the total fixed and operating costs in the present study. At BEP point, difference of sales and variable costs is just sufficient to absorb fixed costs. The break-even point is used by Sathiadhas, Najmudeen, and Prathap (2009) in their study. The formulae used in the study to calculate BEP in value and percentage are given in equations 3.36 and 3.37 respectively.

i. *Break-even point* (*Sales in ₹*): The business/organization starts earning profit when the output or sales activity crosses the break-even point. Output or sales below this point results in loss. BEP is given in value and percentage.

$$\text{Break-even point (₹)} = \frac{\text{Fixed Costs}}{\text{Sales – Variable costs}} \text{ x Sales} \ldots\ldots\ldots\ldots\ldots \mathbf{(3.36)}$$

$$\text{Break-even point (\%)} = \frac{\text{Break even sales}}{\text{Gross revenue}} \text{ x 100} \ldots\ldots\ldots\ldots \mathbf{(3.37)}$$

$$\text{ii. Profit Volume ratio in (\%)} = \frac{\text{Gross revenue–Variable cost}}{\text{Sales}} \text{ x 100} \ldots\ldots \mathbf{(3.38)}$$

iii. *Margin of safety* (MOS in percentage): It is an excess of present sales value over the break even sales. MOS indicates strength of business and relative profitability. High margin of safety indicates that profit will be earned even if there is a fall in the selling price. If the margin of safety is small, a decline in sales value will be a matter of great concern to the fishermen. It is expressed in value and percentage.

Margin of safety (in ₹) =Actual sales- Breakeven sales…………………………...**(3.39)**

$$\text{Margin of safety (in percentage)=} \frac{\text{Profit}}{\text{Profit volume ratio}} \text{ x 100} \ldots\ldots \mathbf{(3.40)}$$

The BEP, PV ratio and MOS formulae were explained in detail by the authors of a book, namely "Financial Accounting" while describing marginal costing (Chopde and D. H. Choudhari (2008) .

The next section 3.9 discusses the socio-economic characteristics of the respondents. It analyses empirical data on socio-economic characteristics of the respondents. Assessment of this helps the researcher to understand profile of the respondents and its impact on motorized and mechanized fishing business.

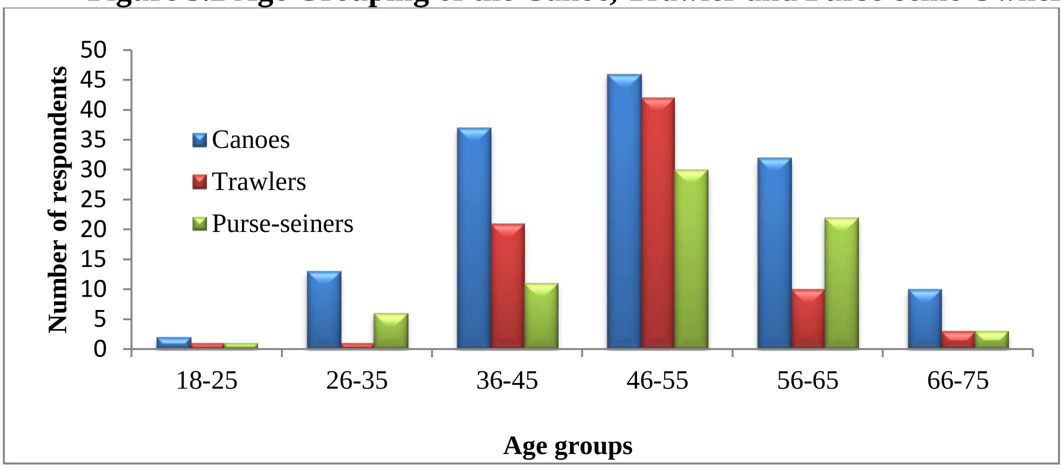
3.9 Socio-economic Characteristics of the Respondents

Socio-economic characteristics of respondents include gender, age, educational status, caste, experience in fishing business and the number of the family members involved in fishing business.

3.9.1 Age Composition of Fishing Craft Owners

A study of the age structure of fishermen is important in estimating the potential of productive human resources (Hussein & Kachwamba, 2009). Figure 3.2 shows that a highest percentage of respondents are in the age group of 46-55 years and they constitute 40.54 % of the total respondents. Most of the respondents involved in fishing business fall in the middle age group. This findings is similar to

Figure 3.2 Age Grouping of the Canoe, Trawler and Purse-seine Owners



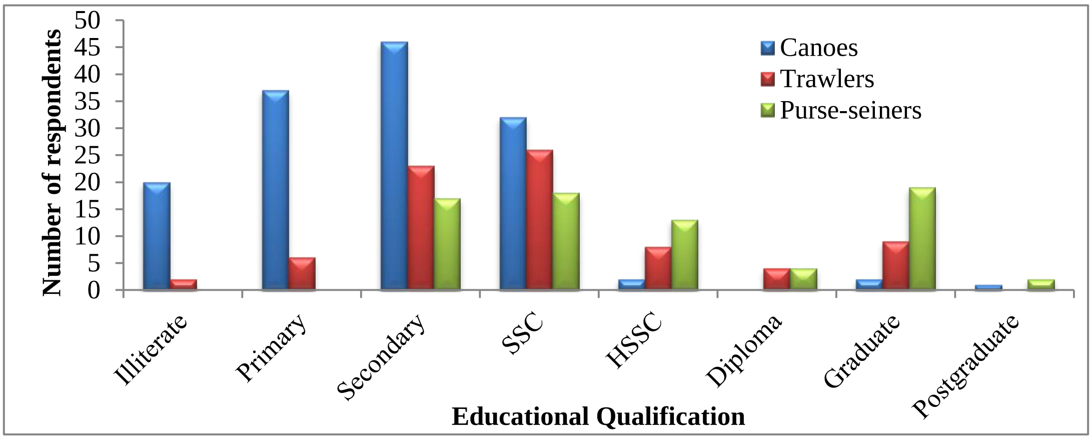
Source: Researchers compilation from primary survey.

findings of (Sujathkumar 2000), (Tyagi et al. 2007) and (Sarma & Bose 2008). Younger respondents in the age group of 18-25 years involved in active fishing were found to be comparatively less, as they are educated and are not interested in the fishing occupation. Also many of them have migrated abroad for better prospects. The age group between 66-75 years was less in number. This could be attributed to the fact that fishing business is a strenuous and hazardous activity and elderly men find it difficult to cope and manage the stress. Also they do not have the stamina to venture into to the sea along with their fishing crafts.

3.9.2 Educational Qualification of the Respondents

According to Marine Census India (2010), the percentage of educated fisher folk was maximum for Goa 86% followed by Kerala 72.5%. However, as per the marine census conducted in 2010 by CMFRI (2010) on fishermen in Goa, 14% of the fisherfolk population was illiterate. Though in the present study, figure 3.3 shows that illiteracy is 7.56% less than that found in the Marine Census of Goa (2010), which covers entire fisher folk of Goa and the present study is only about 291 respondents who own fishing crafts. The highest percentage 29.55% of the respondents had secondary qualification followed by 26.11% who had SSC qualification. However, only 1.03% respondents had professional qualification even though enough

Figure 3.3 Qualification-wise Grouping of the Respondents Owning Canoes, Trawlers and Purse-seine Vessels



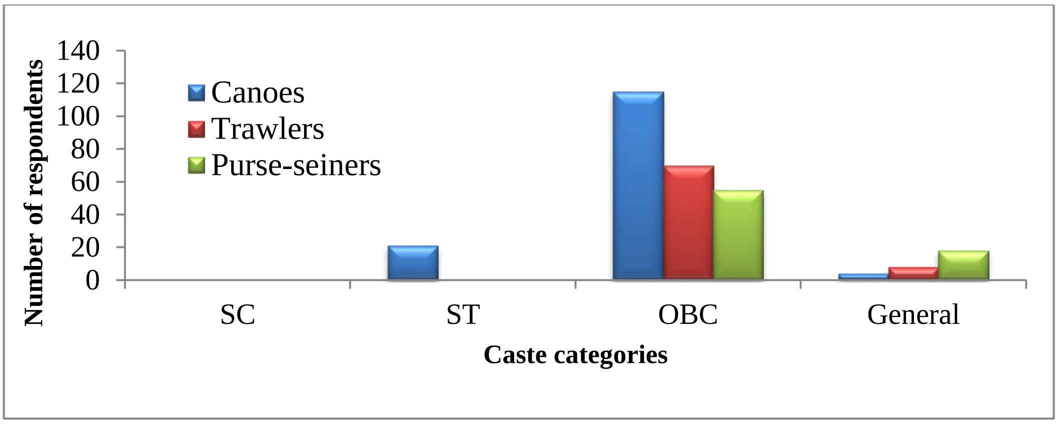
Source: Researchers compilation from primary survey.

educational facilities are available in Goa. The respondents expressed that their family members who are highly educated have joined the manufacturing and service sectors. Most of them have migrated abroad for better prospects.

3.9.3 Caste of the Respondents

Figure 3.4 shows that caste among the fishermen community in Goa is divided into Scheduled Caste (SC), Scheduled Tribes (ST), Other Backward Classes (OBC) and General categories. Those who are traditionally involved in fishing business, the "*Kharvi*" community were categorized under OBC category by the Government. Fig 3.4 shows that 82.47% of respondents belong to the OBC category. The ST respondents are found among canoe owners in Goa. As per CMFRI, Marine Census of Goa (2010), there was no SC/ST population in Goa owning trawlers and purse-seine

Figure 3.4 Caste-wise Grouping of the Fishermen Owning Canoes, Trawlers and Purse-seine Vessels



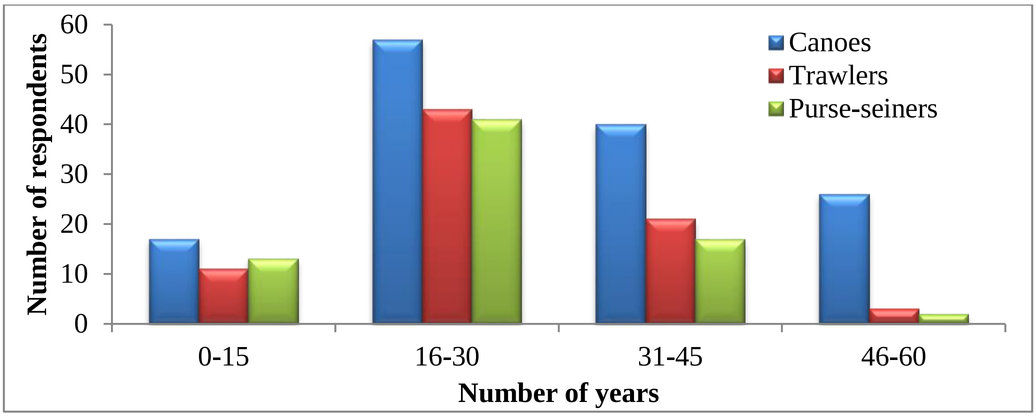
Source: Researchers compilation from primary survey.

vessels. This study substantiates that data. The general category of fishermen is less viz. 10.30% as they have recently ventured into fishing business.

3.9.4 Experience of Fishermen in Fishing Business

Managing any business requires basic skills and experience where it is fishing or any other activity. In figure 3.5 it is observed that the average experience of the

Figure 3.5 Experience-wise Category Grouping of the Canoe, Trawler and Purse-seine Owners



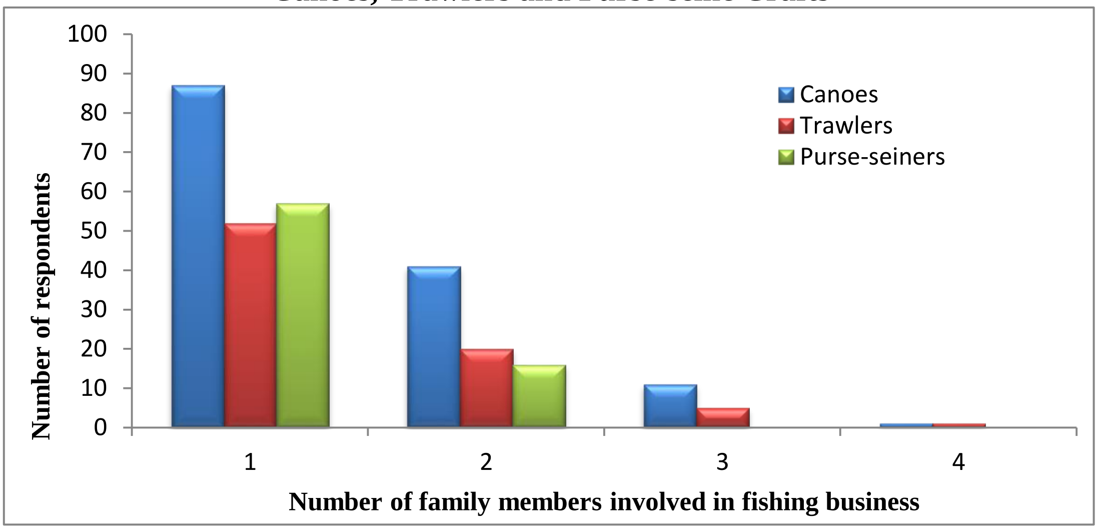
Source: Researchers compilation from primary survey.

respondents in the fishing business is 26 years. It is found that most of the respondent's viz. 48.45% had experience of 16-30 years in fishing business. This is similar to the findings by earlier researcher's like Kiron (1992) and Arul Oli (2004) who found in their studies that fishermen who had an experience of more than 10 years are familiar with handling the business efficiently. In the present study, the experience ranges from a minimum of four years and maximum sixty years among all the respondents. This is a positive indication, whereby respondents have knowledge of the nature of fishing, market, technology involved in fishing, the condition of the sea and in turn these factors help them to handle their business successfully.

3.9.5 Family Members involved in Fishing Business

According to a study by Matiya, (2002) some became fishermen because their ancestors were also fishermen and they learnt the skills from their ancestors as well as inherited fishing crafts and fishing gears from them. Figure 3.6 shows that on an

Figure 3.6 Number of Family Members involved in the Fishing Business of Canoes, Trawlers and Purse-seine Crafts



Source: Researchers compilation from primary survey.

average, in every family, at least one member of the family is actively involved in fishing activity. As much as 67.35% of the respondents had one member of the family and 26.46% had two family members and 6.19% had three family members involved in fishing activities. In case of motorized canoes, there is dominance of fishermen who themselves carry out the fishing activity. In case of fishermen owning trawlers and purse-seine vessels they do not actively participate on onboard fishing operations, but the fishing activity is carried out mostly by the crew employed on the vessel.

3.10 Summary

This chapter explains the research methodology used for the present study. The study on contribution of Goa's fishing industry at the micro-level uses published time series data from a host of sources for over two decades, 1990-2017. It also includes unpublished cross-sectional primary data for the period August 2016 to May

2017 collected through an interview schedule from the fishermen. It explains the statistical and econometric tools used to analyse data used in the study. The trends in marine fish production, inland production and exports, and contribution of fishing industry to state domestic product are analysed using various methods such as trend analysis, percentage analysis, CAGR and the semi-log model. The Coppock Instability Index and the Coefficient of Variation have been used to measure the instability index and evaluate performance of marine production and exports. Parametric test such as independent sample *t* test and one way ANOVA has been used to find significant difference between capital investments, costs, earnings and profit among various sizes of fishing crafts as well as among districts and jetties. Linear and multiple regression models are used to study impact of socio-economic factors on the net profit, earnings and savings from the fishing business. The Cobb Douglas theory has been applied by using log-log model to study impact of selected input of factors of production on the earnings. Economic efficiency of the fishing crafts is examined through the economic indicators and testing the hypotheses using non-parametric test namely; Kruskal-Wallis and Man Whitney U test. The various government schemes given to fishermen are analysed using average and percentage analysis. The CAGR method is used to study growth of government schemes from 1990-2018. Averages and percentage analysis of the schemes is only from 2012-2018. The satisfaction level of fishermen with regard to the schemes and problems faced by the fishermen in fishing business is analysed by using Friedman’s Chi-square test, Fishers and Independent samples *t* test.

Based on the research methodology, information is collected and the data thus obtained, is analysed in the forthcoming chapters. The next chapter four examines the contribution of the fishing industry to Goa’s economy.

Chapter 4

Contribution of Fishing Industry to Goa's Economy

Chapter 4

Contribution of Fishing Industry to Goa's Economy

4.1 Introduction

The Gross State Domestic Product (GSDP) is the most important macro-economic aggregate to measure the growth of any economy. A comprehensive analysis of the composition of Goa's GSDP reveals that there is a systemic change in the pattern of economic development in the State of Goa after liberation since 1961, due to an impressive growth of the manufacturing and service sector, from being largely dependent on the primary sector in the past. In recent years, Goa has witnessed industrial growth in the secondary sector, as well as in the service sector over the recent years. For instance, in the last three and a half decades, during 1980-81 the primary sector of Goa contributed 24.26%, the secondary sector 29.86% while the tertiary sector 45.88% to the state GSDP at constant prices. However, in comparison with the fiscal year 2016-17, primary sector's contribution has declined to 8.40%, whereas the secondary sector's contribution increased to 57.45%; while the tertiary sector's contribution gradually increased to 34.15% of the state GSDP at 2011-12 constant prices based on (Government of Goa, 1981) & (Government of Goa, 2017). This indicates that the secondary and tertiary sector now contribute significantly to the income of the State as compared to the primary sector, unlike the situation in the past. State industrialization has helped the secondary sector, which includes the manufacturing sector which has shown dominant growth and has progressed in the industrial field.

The fisheries sector is classified under the primary sector and is a sub-sector under agriculture. As per the Economic Survey of Goa of 2017-2018, share of fisheries sector of Goa in total state GSDP was 2% in 2015-16, but declined to 0.70% in 2016-17 (Government of Goa , 2018). Goa's marine exports were ₹ 62,317 lakhs in 2017 as compared to ₹ 59,654 lakhs in 2016. This means to say that while the relative contribution of fisheries sector to the State has decreased, it was well compensated by an absolute increase in the foreign exchange, this sector earned for the State. Goa's rich mineral resources and mining was the main contributor to the primary sector till

2012, but the imposition of a ban on illegal mining since September 2012, brought all economic activities to a standstill and reduced its contribution substantially to the primary sector and state GSDP. Over the years it is the secondary and tertiary sector which is contributing significantly to the economy of Goa. Similar is the case for India, the primary sector of India contributed 17%, secondary sector (manufacturing) 31%, and tertiary sector (service sector) 53% of the Gross Domestic Product (GDP) at current prices during the financial year 2016-17. The declining share of primary sector to India's GDP over the years is a major cause of concern to the policy makers which provides jobs to 53% population in the country. Similarly, the contribution of primary sector of Goa is showing a declining trend to the state's income over the years. This chapter presents an overall picture of the trends in fish production, marine exports and contribution of the fishing industry to Goa's economy.

There are various studies done across the globe on fish production and marine exports and its resultant contribution to the economy. The contribution of GSDP to fisheries sector is mentioned in the studies done by Ancy and Raju (2014). A study by Sathiadhas et al., (2014) on contribution of fish production to state GDP indicates that along with fishing, fish harvesting also leads to the growth and development of Goa's economy. Another study by Mayaram (2014) finds that Goa's fisheries sector accounted for 3.10% of total GSDP and 8.01% of the Agriculture sector GSDP at current prices during 2013-14. In another study (Rodrigues, 2004) examined the economics of the fishing industry in Goa by analyzing the trends in marine fish catch, exports of fish from Goa from 1997-2003. The variables used were fish catch, marine exports in quantity and value. The statistical tools used were trend analysis, semi-log model and linear trend models to graph the compounded growth rates for the quantity and value of the total fish catch in Goa. The results indicated that there was growth of the fish production and fish exports in terms of quantity and value during the period 1997-2003. Monteiro (2006) examined the trends of fishery resources in Goa's with reference to Indian mackerel and solar shrimp to examine variations in the marine fishery resources and found that the maximum sustainable yield was 85,407.61 metric tonnes. While in recent years, Ancy (2015) compared the issues faced by India's fishing industry on the basis of Compounded Annual Growth Rate (CAGR) of marine product exports and fish production from India and Kerala. Ancy and Raju (2014) used the CAGR to examine the growth trends in marine exports in India and Kerala and their findings indicate that increasing globalization, liberalization in trade and development of new markets had a great influence on the fisheries sector of Indian economy. Another study by Sagar, Mayuri, and Jyothi (2016), explains the quantum of marine product exports of India using CAGR method.

One significant novelty followed in this chapter on the study of trends is the use of instability indices to document variations in trends. The use of instability index has been preferred in the present study based on the review of numerous recent literature that made use of it to demonstrate the variations in the time trends. Kamat (2007) for instance, used the Coppock instability index to measure the deviation from the trend in the case of iron-ore exports in Goa for the period 1977 to 2007. The author opines that it is important to measure the instability around the trend to separate the export growth of iron ore over the period as a whole from year to year deviations from the growth path, as the later constitutes instability. This study makes use of instability indices concurring the same logic. The Coppock Instability Index and the Coefficient of variation were used to measure the instability index to evaluate the performance of fish production and exports (Radhakrishnan, Ma, J, & Krishnan, 2016). The study found that the growth and instability performance was rather steady during 2006-07 to 2010-11 than the earlier years (2001-02 to 2005-06). Very recently, a study by (Vivekanandan, 2011) shows that the fish epidemic, high cost of production, seasonal variation in catch has reduced the shrimps production in India. Farejiya et al., (2017) analyzed the compound growth rate, instability and trend analysis of marine fish production of the coastal states in India from 2005 to 2015. The authors find that the states of Karnataka and Andhra Pradesh have shown high growth and high instability, but the state of Kerala showed slow down growth and medium range instability, the states of West Bengal, Maharashtra and Odisha show low growth and low instability, Tamil Nadu shows low growth and high instability, while the states of Gujarat and Goa showed medium range of growth and instability.

Apart from the very few studies documented above, Goa’s fishing industry and its manifold contribution to the state’s economy has not been adequately researched. This study tries to fills the research gap and attempts to highlight the contribution of the fisheries sector to the economy since liberalization. The study period commences from 1990-2017. The objective of this chapter is to analyze the trends in marine and inland fish production, marine exports and contribution of fisheries sector to Goa's State Domestic Product. The growth and instability of fish production and exports has been studied to know the performance of fish production and exports of Goa. The importance of the fisheries sector of Goa to the world and the nation is also widely acknowledged. This chapter also makes an attempt to measure the contribution of share of fish production and marine exports of Goa to India and to the world. Thus, by highlighting the share of marine production and exports of the country and Goa, this chapter finally makes inroads for the analysis into the nature and dimension of Goa's marine export market destinations. The present chapter also attempts to throw light on the coefficient of variation, instability index of fish production and marine exports of the world, country and Goa from 1990 to 2017. This chapter is organized into five sections. Second 4.2 presents the policy reforms introduced by the government for the development of India's fisheries sector, it examines the various legislations, section 4.3 gives the historical backdrop and presents the contemporary status of Goa's fisheries sector. Section 4.4 briefly indicates the data sources and research techniques used while section 4.5 elaborates on the results and interpretations and section 4.6 provides a summary.

4.2 Policy Reforms by the Government for India's Fisheries Sector

During the pre-independence era, the fisheries sector in India was unorganized and fishermen were using the non-motorized boats to catch fish only for consumption purpose. After Independence, since 1950, the Central Government implemented schemes in the five year plans providing financial assistance to develop the fisheries sector. The government schemes helped the fisheries sector to be transformed from traditional to commercial sector. The marine fisheries sector in India witnessed phenomenal growth since 1950 to 2017 in both qualitative and quantitative terms. There was an increase in fish production from 0.75 million tonnes in 1950-51 to 11.41 million tonnes in 2016-17. The increase in production was due to technological innovations such as improvements in harvesting methods, motorization, mechanization of fishing vessels, use of artificial/synthetic fishing gears, and increase in fleet size. The Indo-Norwegian project which commenced in Kerala in 1953 also helped to mechanize the Fishing Industry of India. Advent of mechanization helped to construct the fishing vessels of small, medium and large size which could venture for a single day, multiple days and deep sea fishing. All this has resulted in an increase in fishing efforts, fishing hours, fishing in deeper fishing zones, and exploring new fishing grounds with the help of trawlers, gill netters, purse-seiners and ringseiners. There was also an increase in secondary activities such as boat building, net making, fish marketing, processing and other ancillary activities to strengthen the fishing industry. The government also created infrastructure facilities, such as building harbours, fish landing centres, post harvesting operations, processing and marketing facilities in all the maritime states and union territories of India to develop the fisheries sector.

The Government of India and the State Governments have enacted a number of acts and regulations to develop the fisheries sector as well as to improve the socio-economic livelihood of the fishing community. The different legislations, policies and developments are explained in table 4.1. Motorization and mechanization had a great set back on the artisanal fishermen as their catch decreased drastically. The Government of India has amended the constitution in 1976 with the aim of sustainable development of the fisheries sector. Since 1970, an increase in the number of mechanized fishing crafts lead to sectoral conflicts between traditional and mechanized fishing sector in various maritime states of India. Due to these conflicts, the Central Government requested the states to initiative legislative measures by enactment of Marine Fishing Regulation Act (MFRA) to address the issues among the fishermen in the traditional and mechanized sector. Hence, the maritime states passed their own respective Acts. In Goa, the MFRA Act was passed in 1980 to protect the interests of the traditional fishermen. It earmarks the zones for different types of fishing crafts for the non-motorized, motorized and mechanized sector. Since 1995, the Government of India has imposed a fishing ban on all the maritime states and union territories, and the states had to work out their own fishing ban period. An amendment was made to the fishing ban in 2015 where uniform ban on mechanized fishing vessels operating in the Indian Exclusive Economic Zone (EEZ) beyond territorial waters on the west coast including Lakshadweep island was implemented from 1st June to 31st July 2015 (61 days) and for the east coast of India including Andaman and Nicobar Islands the ban period was from 15th April to 14th June 2015 (61 days). The main aim of the ban is conservation, effective management of fisheries resources and the safety of the fishermen. Bio-metric cards are implemented by the Union Government of India in the year 2010-2011 and are issued to fishermen above

18 years of age in all the coastal areas for their safety and coastal security purpose (Government of Goa, 2016).

Table 4.1 Fisheries Regimes, Legislation, Policies and Developments in India

Periods	Fisheries Legislations, Rules and Acts and developments	Objectives
1897	Indian Fisheries Act	Regulation and protection of fisheries resources
1913	Fisheries Co-operative movement	Welfare of fishermen
1943	Restrictive legislations by British	Prevents capture of juveniles
1950-1966	Operation of non-mechanized fishing crafts	Welfare of traditional fishermen
1970	Blue Revolution	Promotes fisheries development
1972	Marine Products Export Development Authority Act (MPEDA)	Promotes export of marine fish products
1976	Maritime Zones Act	Defines the Territorial sea, Continental shelf and Exclusive Economic Zones (200 nautical miles) Act and Brackish Water Act, 1980, and Sustainable development of fisheries
1980	Marine Fishing Regulation Act (MFRA) 1980	Fishing within 12 nautical miles in respective states in the territorial sea.
1981	India Coast Guard Act 1981	Enforces maritime law
	Regulation of fishing foreign vessels Act	Regulates fishing by foreign vessels in Indian EEZ operated by Indian and foreign nationals
1986	Coastal Regulation Zone	Fixes the 500 m high tide line zone
1991	Liberalization, Privatization and Globalization and establishment of DAHD	Economic reforms and development of fisheries sector
	Deep sea Fishing Policy 1991	Responsible and Sustainable Fishing in the EEZ Rules for Deep sea fishing
1995	India signed the U N convention on the laws of the sea and the Code of Conduct for Responsible Fisheries	Manage and conserve worlds aquatic resources
2002	Biological Diversity Act 2002	Protection of biological diversity
	Environment Protection Act 2002	Conservation and sustainable use of resources
2004	Marine Fishing Policy	It demarcates territorial waters for maritime states
2006	Formation of National Fisheries Development Board (NFDB)	Enhances fish production and sustainability
2009	Marine Fisheries Regulation Act 2009	Permits foreign vessels to carry out fishing in Indian sea waters
2016	National Marine Fisheries Policy Act	Sustainability of marine resources of EEZ
	Blue Revolution restructured scheme	Promotes fisheries sector
2017	Ban on bull trawling, pair trawling, LED and artificial lights for fishing	Conservation and sustainability of fisheries resources
	National Policy on Marine Fisheries	Sustainability, socio-economic upliftment of the fishing community, and gender justice,

Source: Researchers compilation from various issues and Annual reports of CMFRI, DAHD.

In 1991, the Government of India under the Ministry of Agriculture established the Department of Animal Husbandry, Dairy and Fisheries (DAHD). The main aim of the DAHD is to manage and control the flow of funds to the livestock, dairy and fisheries sector in all the states of India. It also promotes the development of fisheries and infrastructure through its various agencies. The National Fisheries Development Board (NFDB) assists the states in fisheries development by establishing fisheries infrastructure, promotes marine fisheries development and sustainable harvests of the resources. The Government of India is directly and indirectly providing subsidies to the fishing sector. Direct subsidies are given to the fishermen and indirect subsidies include the development of market infrastructure and post-harvest market operations. India entered into an Agreement of Agriculture with the World Trade Organisation (WTO) to reform the agriculture sector. India as a member of WTO has to adopt rules laid down by WTO while giving grants and subsidies to the fisheries sector. Subsidies which encourage trade are promoted by WTO. India also signed the United Nations Convention in 1995 on the Laws of the Sea and the Code of Conduct for Responsible Fisheries. India is a member of the United Nation's and is actively participating in all the activities of the FAO of the United Nations, promoting sustainable fishing and conservation of fishery resources. Marine Product Export Development Authority (MPEDA) was established in 1972 in India and provides the assistance in the form of export promotion subsidies for the development and promotion of the export of sea food products. MPEDA encourages the processing units in India to diversify value added products which have great demand in the international market. The year 1980 was a turning point for India as sea food export companies were started on the east coast of the country.

In India, as on 2018, the highest numbers of motorized crafts are operating in the States of Tamil Nadu, Kerala and Gujarat. Majority of the trawlers are operating in states of Gujarat, followed by Tamil Nadu, Maharashtra and Kerala. The maximum numbers of purse-seine vessels were operating in the states of Kerala, Maharashtra, Karnataka, Tamil Nadu, Goa and Andhra Pradesh. India possesses large resources in aquaculture located in the major states of Andhra Pradesh, West Bengal, Odisha, Tamil Nadu. The states such as Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu are the key marine states with great potential to contribute to the marine exports. During 2016-17, Andhra Pradesh contributed the highest to seafood exports from India, with 45% share and marine sea food exports were ₹ 17000 crores out of total India's marine exports of ₹ 37,787 crores. In the year 2016-17, the major countries to which India exported marine seafood products were USA with an earnings of 29.91% in US dollars, South East Asia 29.91% US dollars followed by European Union. In 2016-17, the major items of exports of India were frozen shrimps with a share of 38.38% in quantity and 64.50% of total earnings in US dollars, followed by frozen fish with 26.15% in terms of quantity and 11.64% in US dollar earnings (MPEDA, 2017). The main reason for India's positive growth in sea food exports in 2016-17 is the increase in production and diversification in the species of aquaculture, development of infrastructure to produce value added products and increase of "*Litopenaeus Vannamei*" shrimp production. The Central sector scheme namely Blue Revolution started in 1970 was reinforced by the Central Government in 2016. An outlay of ₹ 300 crores funds were allocated to the coastal states and Union territories has helped to increase the growth of capture production by 18.86% and inland production by 26% for the last two years. The Government of India proposed ₹ 386 crores for the fisheries sector in the year 2018-19, out of which ₹ 366 crores are spent for revenue expenditure and ₹ 20 crores for capital expenditure.

4.3 Policy Reforms by the Government for Goa's Fisheries Sector

Goa was liberated from the Portuguese rule in 1961, and was constituted as the 25th state of the Indian Union on 30th May, 1987. During the pre-liberation period, the fisheries sector in Goa was controlled by the office of Captain of Ports and Board of External trade. During 1960-70, there was slight improvement as government allowed an increase in the size of motorized and mechanized fishing crafts. The Directorate of Fisheries Department, Government of Goa was established in 1963 (Government order No DF-372-FYP-62-67,dtd 2/1/63). The main objective of the Fisheries Department was to increase fish production by using the available natural resources, and improve the socio-economic conditions of the fishing community who belong to the weaker sections of the society (Government of Goa, 2015). The state of Goa has passed several acts and amendments and has taken policy decisions over the years for the benefit of the fishing industry. To mention a few, The Goa Daman and Diu Marine Fishing Regulation Act 1980, Goa Daman and Diu Fishing Rules, 1981, The Goa Brackish Water Fish Farming Regulation Act 1991, Goa Brackish water Fish Farming Rules 1994, and the Coastal Aquaculture Act 2005. The state is empowered to implement legislations to conserve marine ecology. The Goa Daman and Diu Marine Fishing Regulation Act (MFRA) passed in 1980 specify the rules and regulations for the traditional and mechanized sector. This act was passed to protect the interest of traditional fishermen and conserve the depleting marine resources due to overexploitation. As per the MFRA Act 1980, the Directorate of Fisheries, Government of Goa deals with the process of registration of boats, fishing gears (nets) and issues licenses to the owners of non-motorized, motorized canoes, mechanized fishing vessels in Goa and also renews the licenses of the same. Every fishing boat has a vessel registration certificate issued by the authorities of the Fisheries, Department. Each fishing boat is identified with a name given by the owners of the fishing crafts. As per the MFRA Act the owner registers the fishing craft with the Fisheries Department within 30 days of becoming an owner. Fishermen have to renew the boat and net license every year by paying a nominal fee to the government. The Fisheries Department and the Captain of Ports scrutinize the documents of the traditional canoes and mechanized vessels and issue license to the owners. As per the MFRA Act, the mesh size of fishing gear allowed by the government is 24 mm to catch fish and 20 mm to catch prawns. The MFRA act empowers the department to seize canoes and vessels involved in illegal fishing. The Fisheries Department also monitors the illegal fishing activities through the Coast Guard and the Monitoring, Controlling and Surveillance Department. The Monitoring, Controlling and Surveillance Department checks the illegal fishing activities. As a coastal security measure and for the safety of fishermen, an uniform colour code for fishing crafts has been implemented by the state. The colour code comprising of white colour for the hull and black fenders for motorized and non-motorized canoes and white hull, black fenders and sky blue cabin for trawlers and purse-seine fishing vessels in Goa.

The fishery sector in Goa was not developed till 1980. From 1980 to 1990, only 42 feet trawlers and purse-seine vessels were introduced for multi-day, deep sea fishing of 5-10 days fishing trips. These fishermen started using technological equipment and advanced communication devices such as fish finders to locate shoals of fish which ultimately helped them to increase the catch per unit of effort, ultimately helping to increase productivity. The number of mechanized vessels increased after 1990 since government allowed building of 49 feet size vessels. Thus, mechanization and adoption of new technologies affected the catch of traditional fishermen in Goa. In 1975, the agitation of the traditional fishermen led to the formation of the fishermen association locally known as "*Goencho Ramponkarancho Ekvott*" (GRE).

The agitation was called off in 1994 when the Supreme Court passed an order that banned mechanized fishing within 5km from the shore (Raikar and D'Cruz, 2004).

Since 2001, the government has taken policy decisions for resource conservation and sustainability. It maintains control on the increase of the fishing fleet by the adoption of quota system. In 2001, the fisheries department allowed a quota of five vessels per person (Ref 2001order JSF/ENF/Ammds/Act 2001 dated 7/9/2001). However, this rule was changed subsequently in 2007 and the Department allowed one person to register only two mechanized vessels (2007 order m1-22-2006/FSH/dated 14/2/2007). Since 2005, the Government of Goa has permitted mechanized vessels up to overall length of 23m. Thereafter, in 2007 government granted permission for construction/purchase of a total of new vessels for the state up to 25 per year against replacement of old/sunk vessels. Lately in 2015, the Government increased the quota from 25 to 35 vessels per year enabling the fishermen to go for deep sea fishing using advanced technology and fishing techniques and equipment. The present policy decision of the government of two mechanized vessels per person curtails the monopoly by certain families, as well as allows new entrants in fishing business.

The mechanized fishing vessel owners have to report to the director of sub-office at all jetties after every trip. Marine fishing in Goa is carried out from August to May. In 1995, Government of Goa introduced the first monsoon fishing ban of 54 days for all the mechanized vessels from 1st July to 24th July. The number of days of fishing ban was subsequently revised as per the demands of fishermen. The present fishing ban in Goa is from Ist June to 31st July, a period of 61 days which is in uniformity with the central ban for the west coast of India. The motorized canoes fitted up to 10 HP outboard using gill net and non-motorized canoes are exempted from the ban. The fishing bans in Goa have been continued from 1995 till date. However, over the years amendments were introduced to revise the ban period as per the demands of the fishermen and also for the purpose of conservation. Since the traditional fishermen and trawler owners were getting less fish catch due to illegal fishing, they protested in 2015 requesting the government to ban LED fishing by purse-seine vessels. Hence, the State Government as per the order of Central Government issued by DAHD (F.No.21001/3/2014) banned illegal fishing from 10th

May 2016 through the use of LED light, light attractors either with or without generator.

Right from 1964, the Department of Fisheries and Registrar of Co-operative Societies encouraged the fishermen in Goa to form fisheries co-operative societies. The Fisheries Department provides government schemes in the form of subsidies, grant in aid and contribution to the fishing community. Government of Goa has made it mandatory for the owners of mechanized vessels to install Vessel Tracking System (VTS), Very high frequency (VHF), and carry safety equipments such as life jacket and life buoy on board. However, the motorized canoes have to carry only life jacket and life buoy. As per government rules, it is compulsory for the fishermen in Goa to maintain a log book indicating fishing trips, fuel consumed per trip, quantum of catch and the species of fish caught. This is used as documentary evidence for claiming subsidy on fuel annually from the Government of Goa. The Fishermen Association and Co-operative societies established in the State acted as mediators between the government and the fishers. These associations and societies communicate all decisions implemented by the government through the Fisheries Department for the benefit of fishermen in Goa. The Government also informs the fishermen through fishermen associations and co-operative societies about the weather conditions with regard to their safety. Thus, these fishermen associations and co-operative societies also play a significant role in the development of fisheries sector in Goa.

4.4 Data Sources and Techniques

The study relies on secondary sources extracted from a host of sources. The time series data for the analysis is from the period 1990-2017 i.e (27 years). The period selected is the beginning of liberalization period of the Indian economy and many developments in the fisheries sector in India took place since 1991. The entire time series secondary data is analyzed by considering the sub-periods and full-periods. It is classified into six sub-periods, 1990-1995, 1995-2000, 2000-2005, 2005-2010, 2010-2017 and full period is 1990-2017 for the purpose of trend analysis. Simple averages and relative percentages are calculated over the sub-periods to derive results. The data of Gross State Domestic Product of Goa from 1990 to 2017 is taken from the publications of Reserve Bank of India. The data on marine, inland fish production and marine exports of World from 1990-2017 is drawn from the

‘Compiled FAO Statistics of Fisheries and Aquaculture Statistics’ published by State of World Fisheries and Aquaculture, Rome.

The marine and inland fish production data of India from 1990 to 2017 is sourced from publication of annual report of Department of Animal Husbandry, Dairy and Fishery, Government of India and annual report of CMFRI. The data on marine and inland fish production of Goa’s fisheries sector from 1990 to 2017 is compiled from the data obtained from the Directorate of Fisheries, Department of Goa, Handbook of Statistics, Department of Planning and Statistics, Government of Goa and Goa’s Economic Survey. Data of marine exports of India from 1991 to 2017 was obtained from annual publication of Marine Products Export Development Authority (MPEDA). Marine exports data of Goa from 1990 to 2017 is sourced from the annual reports and websites of MPEDA. Marine exports of Goa to the different countries of the world are assembled from publication of MPEDA from the 1995 to 2017. Data of species-wise marine fish production of Goa is taken from 1990 to 2017 from Fisheries Department, Government of Goa from 1990-2017. The variables used in the study are GSDP of the primary sector and state GSDP, marine and inland fish production of World, India and Goa, marine exports of World, India and Goa from 1990 to 2017. Like all other studies, this analysis of data also suffers from the limitations of unavailability of sufficiently broader secondary data. The marine exports data from Goa to different countries of the world was not available from 1990-1994. The jetty-wise marine fish catch data of Goa was not available from 1990-1997 and also for the year 2017. Hence, the marine export data from 1995 to 2017 and jetty-wise marine fish catch data from 1998-2016 was considered for the purpose of the data analysis.

There is usually fluctuation in the value of any currency over a period of time. In case of GSDP data of Goa, the base years were changing after every four years, hence the splicing method is used to make adjustment for the base year and get one series. Thus, one base year as 2004-05 at constant prices is taken for the GSDP data of Goa for the purpose of data analysis since data was available for this base year 2004-05. Constant prices were taken to avoid inflation and price effect. The Compound Annual Growth Rate (CAGR) at constant prices is estimated to give the real picture of contribution of Goa’s fishing industry to states income. The contribution of fisheries and mining sector to primary sector and state GSDP of Goa is analyzed by using percentage analysis and CAGR method to measure growth of the same. The CAGR is worked out to estimate the trends in marine, inland fish production and marine exports of fish in India and Goa. The study uses semi-log regression models to compute the CAGR for the entire period 1990-2017 for state GSDP of fisheries, mining, primary, marine production and exports of Goa.

The growth in marine fish production and quantity exported of World, India and Goa is analyzed using the exponential growth function mentioned in the research methodology chapter section 3.8, equation no 3.5. Semi-log regression model is used to calculate the growth rate of marine, inland production, marine exports of India, and Goa, as given in equation 3.10, 3.11 and 3.12 respectively. In these equations, Y_t denotes the dependent variable and X_t denotes the independent variable time under the study respectively. Ranking method is used to highlight the changing composition of country wise destination of Goa's marine exports (in terms of quantity). In order to estimate the variability and instability in marine, inland production and exports, of World, India and Goa, coefficient of variation is calculated for the sub-periods and compared with each other. The Coppock Instability Index is also used as a measure of variability and is computed by using the formula given in section 3.8 equation no. 3.6 and 3.7. Coefficient of variation is calculated by using the formula given in the research methodology in section 3.8 equation no 3.8 and 3.9. The Coppock Instability Index was applied to estimate the extent of variability in marine, inland fish production and marine exports of World, India and Goa for the period 1990-2017. This technique was devised by Coppock and has been used in fisheries to estimate the extent of variability. The Coefficient of Variance (CV) is used to measure variability and is intended to measure instability index.

4.5 Results and Interpretations

The results are arranged into seven sub-sections 4.5.1 to 4.5.8 and presented in that order as follows:

4.5.1 The Global, National, Regional Marine and Inland Production Trend

This section discusses the Global, National, and Regional marine and inland fish production trend. The sub-period averages reflecting comparative share of India and Goa's marine and inland production to the world's total marine and inland fish production are summarized in table 4.2. Results in table 4.2 shows that in the period

2010-2017, total share of production from India including marine and inland to the world in absolute terms increased to 5.41% as compared to 4.10% in 1990-1995. In

Table 4.2 Comparative Trends in Marine and Inland Fish Production of World, India and Goa, from 1990 -2017 (Relative Percentages)

(Production Qty in 000 tonnes)

Period	India/World			Goa/India			Goa/World		
	Marine	**Inland**	**Total**	**Marine**	**Inland**	**Total**	**Marine**	**Inland**	**Total**
1990-1995	2.87	10.00	4.10	3.56	0.17	2.14	0.10	0.02	0.09
1995-2000	3.01	9.48	4.42	2.65	0.14	1.47	0.08	0.01	0.07
2000-2005	2.98	9.51	4.68	2.84	0.12	1.40	0.09	0.01	0.07
2005-2010	3.07	9.22	5.06	2.99	0.08	1.27	0.09	0.01	0.06
2010-2017	2.95	10.24	5.41	3.01	0.07	1.17	0.09	0.01	0.06
Full period 1990-2017	**2.85**	**9.19**	**4.61**	**3.13**	**0.10**	**1.47**	**0.09**	**0.01**	**0.07**

Note: Percentage is computed from production in (000 tonnes), **Source:** Computed from various issues of FAO, Statistical Handbook of India and Goa, Economic Survey of Goa. Data of World, India and Goa of production for the year 2017 is provisional.

India, fish production has increased over the years particularly from inland which includes aquaculture. During 2010-2017, the share of India's inland production to the world has recorded growth of 10.24% as compared to 10% from inland production in absolute terms in 1990-1995. However, during the same period share of marine production of India to the world was 2.95% as compared to 2.87%.

In the year 2016-2017, India was the second major player in terms of aquaculture production and third in terms of marine production in the world. In 2017-18, CMFRI estimates marine fish landings of 3.88 million tonnes which is 6.9 % more than 2016-17. There was 5.6% increase in fish landings in 2017 as compared to 2016 (ICAR, 2018). The reasons of inland and freshwater aquaculture becoming a major contributor of fish production in India is due to the availability of inland resources and an initiative taken by Government for the past three decades through the fish farmers agencies of DAHD. The countries which were major aquaculture fish producing countries in 2016 were China, followed by India, Indonesia, Vietnam, Bangladesh and Norway. The analysis of the inter-period percentage change shows a positive impact of liberalization on India as the percentage share of India's total production to the world production has increased. The marine fish production increased in India from 1990 to 2000 due to introduction of motorization of crafts and increase in the number of mechanized vessels. Indian remote sensing satellite launched in 1999 helped to exploit the marine resources. Since 1999, the fishermen in India used advanced technology, fish finders to exploit fisheries resources. However, the marine production of India is not showing a constant trend from 1990 to 2017.

In terms of value the marine production of Goa contributed to ₹ 2874.93 lakhs in 1990 which increased to ₹ 62,317 lakhs in 2017 (Economic Survey, Goa, 1990; 2018). The average production of fish in Goa during the period from 1990 to 2017 was 96%, from the marine sector and four percent from the inland sector. As per table 4.2, out of the total production in India, Goa's share to the country's production has shown a decreasing trend. The same trend is observed in Goa's share to the world. Goa's share of marine as well as inland production to the nation has decreased in 2010-2017 as compared to 1990-1995. Goa's share in the marine and inland national production was highest during the periods 1990-1995. Since 1995 to 2017, Goa's share in the national marine production has witnessed an inconsistent trend whereas the state's share in national inland production has showed a decreasing trend. During the years 1993, 2005, 2014, and 2015, Goa witnessed high fish catch in marine production. An increase in marine production of the species from 1995 was due to an increase in mechanized fishing vessels such as trawlers and purse-seine vessels, when the Government of Goa passed a regulation to increase the size of vessel to be built or purchased by the fishermen, from 48 feet to 60 feet. Later in 2007 onwards as per fishermen's demand, the State Government increased the size of vessels from 60 feet to 75 feet. This introduction of bigger size mechanized purse-seine fishing vessels of OAL (overall length of the boat) of around 75feet, and increase in number of fishing fleets in Goa have helped the fisherman to venture into deep sea for multiday fishing, thereby increasing the marine fish catch and gross earnings.

In table 4.3, the CAGR of India to the world for the full period is showing negative growth in case of marine production in relative terms. On the other hand, CAGR of India's Inland production to the world shows a positive trend. The CAGR of Goa to India and to the World is showing negative growth for the full period. The (CMFRI, 2014) reports have attributed the decline of fish catch for many reasons such as the deep sea effect mainly the EI Nino effect, increased mechanization, over fishing and overexploitation of marine resources. The other factors responsible for marine production showing a fluctuating trend are non-adherence to mesh size of gear, fishing beyond sustainable limits, climate change, marine pollution, hazardous methods like bull trawling, LED fishing practiced by mechanized vessels, high speed boats along with several other factors. On the other hand, problems faced by inland sector are lack of credit facilities, insurance schemes, lack of standardized technology

Table 4.3 CAGR's Relating to Marine and Inland Fish Production of World, India and Goa, from 1990-2017 (Relative Percentages) (Qty in 000 tonnes)

	India/World			Goa/India			Goa/World		
Period	**Marine**	**Inland**	**Total**	**Marine**	**Inland**	**Total**	**Marine**	**Inland**	**Total**
1990-1995	0.004	-0.014	0.010	-0.019	0.010	-0.033	-0.016	-0.004	-0.023
1995-2000	0.012	0.011	0.023	-0.098	-0.040	-0.113	-0.088	-0.029	-0.093
2000-2005	-0.011	-0.006	0.005	0.107	-0.023	0.071	0.095	-0.029	0.077
2005-2010	0.026	0.007	0.031	-0.048	-0.114	-0.073	-0.024	-0.108	-0.044
2010-2017	-0.036	0.048	0.008	0.038	-0.006	0.031	0.000	0.042	0.040
1990-2017	**-0.003**	**0.007**	**0.013**	**0.002**	**-0.033**	**-0.017**	**-0.003**	**-0.026**	**-0.004**

Source: Same as table 4.2.

and non-availability of fingerlings of desired size.

The fisheries sector is classified under primary sector and is a sub-sector under agriculture. Contribution of the fishing industry to the development of the state economy is measured by its percentage share in the primary sector and its share in the total output of the primary sector which is given in section 4.5.2.

4.5.2 Contribution of Fishing Industry to Goa's Economy

Presently the manufacturing and service sectors contribute a major share to the state's economy. Table 4.4 presents an analytical enquiry of the contribution of the State's primary sector and fishing industry in composition of the State Domestic Product (GSDP) and fishing industry's share in primary sector, at constant prices. It also analyses share of mining industry to the state income and primary sector of Goa. Measured in constant terms a decrease is evident from 14.20% in 1990-1995 compared to 6.34% in the year 2010-2017 of primary sector to State's GSDP. The average share of primary sector to state's total GSDP is highest during post liberalization from 1990-1995, but declined drastically during 2010-2017. The share of mining to primary increased till 2010 but later declined since 2012 to 2017. Within the primary sector, average contribution of mining to primary during 2010-2017 stands at 53.89%, fishing to primary is 21.71% and the rest contribution by agriculture, forestry and logging to primary sector is 24.40%. The share of agriculture to primary sector has increased due to the steps taken by the government of Goa to revamp the agriculture sector. The share of fishing to primary sector has not remained stable from 1990-1995 to 2010-2017. The average share of the fishing to the primary sector has increased from 16.66% in 1990-1995 to 21.71% in 2010-2017. It showed an increasing trend during 2000-2005 and 2010-2017 periods. The contribution of

Table 4.4 Sub-Period Averages Relating Role of Primary, Fishing and Mining Sector to Goa's Economy, 1990 to 2017 (Expressed in Percentages) (Base year 2004-05) at constant prices (Rs in Lakhs)

Period	Primary/ GSDP	Fishing/ Primary	Fishing/ GSDP	Mining/ Primary	Mining/ GSDP
1990-1995	14.20	16.66	2.36	29.75	4.40
1995-2000	13.24	14.15	1.89	41.35	5.50
2000-2005	9.98	16.97	1.69	42.04	4.19
2005-2010	10.03	14.06	1.42	59.91	5.98
2010-2017	6.34	21.71	0.93	53.89	4.50
Full period 1990-2017	**10.47**	**17.12**	**1.61**	**45.76**	**4.89**

Note: a. Primary/GSDP denotes percentage share of Primary sector to Total Gross State Domestic Product, b. Fishing/Primary denotes the percentage share of Fishing Industry to Primary sector, c. Fishing/ GSDP is the share of Fishing Industry to Goa's Total Gross State Domestic Product, d. Mining/Primary denotes the percentage share of Mining to Primary, e. Mining/GSDP is the share of Mining to GSDP, **Source:** Computed from various issues of RBI data, Goa Statistical Handbook, Directorate of Statistics, Government of Goa.

fishing to agriculture GSDP is showing an increasing trend from 1995 to 2017. Thus, the fisheries sector plays a significant role in primary sector of the state.

The study finds that contribution of fishing to the State total GSDP has drastically declined from 2.36% in 1990-1995 to 0.93% in 2010-2017. This is due to marine and inland production showing a stable trend. Mining is sub-sector included in the primary sector in Goa, considered as a backbone of the economy till 2011-12. The share of mining to primary has increased from 29.75% in 1990-1995 to 53.89% in 2010-2017. However, as per Supreme Court order, a ban was imposed on illegal mining in Goa in October 2012. Since then the contribution of mining to primary sector drastically dropped from 59.91% in 2005-2010 to 53.89 % during 2010-2017. After mining ban, the share from agriculture contribution has increased towards the primary sector. The share of mining to GSDP has increased from 4.40% in 1990 to 5.98% in 2010, but declined to 4.50% in 2010-2017. The contribution of mining to GSDP showed a fluctuating trend from 1990 till 2017. The contribution of mining to GSDP has declined during 2000-05 periods and also after 2010-16, but as compared to the contribution of fishing to GSDP, mining contribution is higher than fishing contribution for the same period. Overall, the contribution of agriculture and allied to GSDP is 5.58%, and mining to GSDP is 4.89% for the period 1990-2017.

The table 4.5 provides a break-up for the sub-period from 1990-2012 of the contribution of primary sector, fishing industry and mining industry before the mining ban and after the mining ban from 2012-2017. Since 2013 to 2017 the share of primary to GSDP, fishing to GSDP and mining to GSDP has been declining. However, during 1990-2012, the contribution of fishing to primary was 15.01% which has further increased to 26.37% in 2012-2017, however, the share of fishing to GSDP

Table 4.5 Sub-Period Averages Relating Role of Primary, Fishing and Mining Sector to Goa's Economy, during the Pre-Mining Ban 1990-2012 and Post-Mining Ban Periods 2012-2017

(Expressed in Percentages) (Base year 2004-05 at constant prices) (Rs in Lakhs)

Period	Primary/ GSDP	Fishing/ Primary	Fishing/ GSDP	Mining/ Primary	Mining/ GSDP
Pre-mining ban period 1990-2012	12.01	15.01	1.79	46.00	5.52
Post-mining ban period 2012-2017	3.65	26.37	0.81	44.70	2.11
Full period 1990-2017	**10.47**	**17.11**	**1.61**	**45.76**	**4.89**

Note and Source: Same as in table 4.4.

decreased during the same period from 1.79% to 0.81%. The mining sector contribution to primary sector which was 46% in 1990-2012 has declined to 44.70% and the mining contribution to GSDP has drastically decreased from 5.52% to 2.11 % for the same period.

Table 4.6 shows the CAGR of the primary sector to GSDP, fishing to primary and fishing to GSDP. Goa's contribution of primary to GSDP has decreased since 1993 to 2001. Goa's share of primary to GSDP has also been increasing from 2002-03

Table 4.6 CAGR's using Semi-Log Regression Relating to Contribution of the Primary and Fishing Sector in Goa's Economy, 1990 to 2017

Dependent Variables	Regression Equation	Compound Annual Growth (%)	*t*-value	Significance
Primary/GSDP	$Log\ Y$=2.97- 0.053X	-5.16	-4.56	0.000*
Fishing/Primary	$Log\ Y$ =2.64+0.01X	1.00	1.08	0.21
Fishing/GSDP	$Log\ Y$=1.01-0.043X	-4.20	-8.66	0.000*

Notes: *indicates statistical significance at 1% level. **Source**: Computed from various issues of RBI data, Goa Statistical Handbook, Directorate of Statistics, Government of Goa.

to 2007-08. It shows a slow growth rate. After 2012-2013, till 2017 there is a drastic decrease of Goa's contribution of primary sector to GSDP due to the mining ban. Due to this the CAGR of the primary sector to GSDP from 1990 to 2017 decreased to 5.16 % statistically significant at 1% significance level. Similarly, during the same period share of fishing to GSDP has reduced to 4.20% statistically significant at 1% significance level. Thus, in both these cases, the CAGR of primary sector and fishing sector to GSDP is statistically significant at 5% significance level, but there is negative growth. The CAGR of fishing GSDP to Primary GSDP is not statistically significant, but the growth is showing a positive trend. This implies that there is constant growth of fishing to primary sector.

Table 4.7 shows that the CAGR measured from 1990 to 2017 for primary to GSDP showed negative growth of 0.079 %. Similarly, the CAGR of fishing to GSDP relatively also decreased from 1990 to 2017 to 0.053%. However, the CAGR of fishing to primary has been positive from 1990 to 2017 i.e 0.028%. The CAGR of mining to primary was positive at 0.10% and the CAGR of mining to GSDP was 0.01% for the period 1990 to 2017.

Table 4.7 CAGR's Relating Contribution of the Primary and Fishing Sector in Goa's Economy, 1990 to 2017 (in Percentages)

Periods	Primary/ GSDP	Fishing/ Primary	Fishing/ GSDP	Mining/ Primary	Mining/ GSDP
1990-1995	0.069	0.037	0.108	0.168	0.248
1995-2000	-0.065	-0.037	-0.102	-0.038	-0.103
2000-2005	-0.004	0.001	-0.004	0.064	0.059
2005-2010	0.001	-0.102	-0.101	0.134	0.135
2010-2017	-0.140	0.089	-0.064	0.078	-0.073
Full period 1990-2017	**-0.079**	**0.028**	**-0.053**	**0.100**	**0.014**

Note and Source: Same as in table 4.4.

Table 4.4 to 4.7 brings to light the decreasing contribution of the primary sector to the States GSDP. The fishing share to the primary sector has increased but shows declining trend to the State GSDP. When the share of mining to the primary sector has decreased the share of fishing to primary has increased during 2012-2017. But during the same period 2012-2017, the share of fishing as well as mining to States output has decreased. The share of other sectors namely manufacturing and service has contributed 89.53% to the States income during 1990 to 2017 and the contribution of primary to States income is only 10.47%. The fishing share contribution to the state income in absolute terms has increased from ₹ 8,017 lakhs in 1990-91 to ₹ 30,543 lakhs in 2016-2017. This is due to the increase in the share of marine exports from Goa. The contribution of the fisheries sector to the state's income has declined from 2.36 % in sub-periods 1990-1995 to 1.65% in 2010-2017. The manufacturing and service sectors contribution to state income in 1990-1995 was 85.80% which increased 89.26% in 2010-2017. The reason attributed to the changes in the sectoral composition is due to the outperformance of the manufacturing and service sectors of the economy as well as the policy decisions by the government of Goa in developing these sectors. The government needs to concentrate in developing the primary sector due to its declining share through the implementation of various schemes.

4.5.3 Composition of Goa's Marine Species-wise Fish Production

The total marine production of different species of fish catch in metric tons, composition of different marine species and average production from 1990 to 2017 sub-periods are reflected in table 4.8. In Goa, the dominant species are pelagic, followed by demersal, crustaceans and molluscs. The other marine species represents Cuttle fish, Tuna, Ribbon fish, Reef cod, Kowala kowal, Golden Anchovy, Silver Belly, Soles, Silver Bar, Crabs, Sciaenoids, Butter fish. It is evident from table 4.8 that for the entire period, from 1990-2017, Goa's marine fish production which includes other species is significantly large (36.66%), followed by sardines 30.19%, mackerels 20.91% and demersal species such as prawns at 6.87%. The production of

Table 4.8 Goa's Marine Species-wise Fish Production from 1990-2017

(Percentage of marine species to the total marine production) (Qty in metric tons)

Periods	Mackerals	Sardines	Catfish	Shark fish	Seer Fish	Prawns (shrimps)	Pomprets	Other marine species	Average Production (MT)
1990-1995	27.19	12.21	0.81	0.32	1.46	4.20	0.47	53.34	90115
1995-2000	32.31	21.35	0.77	0.92	1.49	4.07	0.88	38.21	75178
2000-2005	11.37	35.71	1.81	1.75	4.72	6.37	0.85	37.42	81637
2005-2010	19.78	31.62	2.15	1.57	3.43	10.12	0.45	30.88	88806
2010-2017	17.14	42.07	0.62	0.34	2.11	8.29	0.90	28.53	102661
Full period 1990-2017	**20.91**	**30.19**	**1.17**	**0.90**	**2.58**	**6.87**	**0.73**	**36.66**	**88789**

Source: Computed from various issues of Goa Statistical Handbook, Directorate of Statistics, Government of Goa and the Statistics from the Fisheries Department, Government, Goa.

other marine species such as seer fish, cat fish, shark fish and pomprets remains meager at 2.58 %, 1.17%, 0.90% and 0.73 % respectively. However, the production of species such as pomprets, shark fish has decreased due to overfishing and overexploitation. The production of sardines has increased from 12.21 % from 1990-1995 to 42.07 % in 2010-2017. Overall from 1990 to 2017 there is an increase by 29.86% in case of sardines. The production of pelagic species such as mackerels have been more dominant from 1990 to 2000, but showed a decline from 2000 onwards till 2017 showed a fluctuating trend. The production of other species has decreased from 1990 to 2017. Average marine fish production since the year 2000 is showing an increasing trend. The monsoon fishing ban of 61 days ensures that fish gets time to breed and to procreate to make the progeny available to fishery stock. A study finds that there is depleting marine fish catch in India. Also, the catch of shrimps, lobsters and high value fishes have shown a downward trend over the years (Salim, 2012).

A comparative analysis of CAGR among the marine species is shown in table 4.9. It is hypothesized that "There *is significant growth of marine species from 1990 to 2017".* The null hypothesis proposed is "There *is no significant growth of marine species of Goa in quantity from 1990 to 2017".* Log was calculated for all the species of marine fish. The species of marine fish is dependent variable and time in years is independent variable. The results of semi-log regression model in table 4.9 showed that the CAGR of species such as sardines, sheer fish, prawns and total species shows

Table 4.9 CAGR's using Semi-log Regression Model Relating to Species-wise Marine Fish Production in Goa, from 1990 to 2017

(CAGR's expressed in Percentages) (Qty is tons)

Species	Regression Equation	Compound Annual Growth (Percentage)	*t-value*	Significance
Mackerels	*Log Y* = 9.75- 0.005*Xt*	-0.49	-0.40	0.71
Sardines	*Log Y* = 8.61+0.08*Xt*	9.31	3.17	0.001*
Catfish	*Log Y* = 6.46+0.01*Xt*	1.61	0.83	0.41
Shark fish	*Log Y* = 5.86+0.02*Xt*	2.94	1.13	0.26
Seer fish	*Log Y* = 7.08+ 0.03*Xt*	3.46	2.62	0.01**
Prawns	*Log Y* = 7.79+0.05*Xt*	5.54	4.31	0.00**
Pomfrets	*Log Y* = 5.91+0.02*Xt*	2.63	1.67	0.10
Other species	*Log Y* = 10.55-0.01*Xt*	-1.58	-2.00	0.05***
Total marine species	*Log Y* = 11.24+0.01*Xt*	1.00	2.37	0.02**

Note: Variable * significant at 1%, ** significant at 5%**, *** ** significant at 10% level of significance**,**
Source: Computed from various issues of Goa Statistical Handbook, Directorate of Statistics, Government of Goa and the Statistics provided by the Fisheries Department, Government of Goa.

significant growth, whereas mackerel and other species showed negative growth during the periods 1990 to 2017. Sardines species showed CAGR of 9.31%, Prawns (shrimps) show a positive growth of 5.54%, both statistically significant at 1% significance level. Seer fish (kingfish) has grown at 3.46% statistically significant at 5% significance level, and total marine species with CAGR of 1% statistically significant at 5% significance level. Thus, in the case of CAGR of species such as sardines, seer fish, prawns and total species, the null hypothesis is rejected concluding that there is significant growth of sardines, seer fish, prawns and total species. In case of other species, CAGR registered negative growth of 1.58%, statistically significant at 10% significance level, rejecting the null hypothesis. In case of total species, there is a positive growth of 1% statistically significant at 5% significance level, rejecting the null hypothesis. In the case of the remaining species, mackerels, catfish, sharkfish and pomprets the growth is not statistically significant, whereas pelagic species (mackerals) only showed negative growth for the period 1990-2017.

The dominant pelagic species in the state production are mackerels and sardines which has been contributing to around 50% of the total marine catch from 1990-2017. This corroborates with the 2015 findings of the Fisheries Department, which states that pelagic species viz. mackerels and sardines form 50% of the total marine catch (Goa Fish Trails, 2015). The next dominant species have been the prawns, squids and cuttle fish. These are also commercially important species of the state, which contribute largely to the marine exports. The average marine production increased since 2000-2005 onwards from 81,637 tons to an average of 1,02,661 tons in 2017, mainly because of active participation of the Government in mechanization of the fleet by providing schemes in the form of financial assistance i.e subsidies to the fishermen in Goa.

4.5.4 Jetty-wise Marine Fish Catch in Goa

Table 4.10, reveals the contribution of five landing centres in Goa, namely; Malim, Cutbona, Vasco, Chapora, and Talpona through which the fishermen operate their trawler and purse-seine vessels in fishing business. Table 4.10 depicts that

Table 4.10 Jetty-wise Marine Fish Catch of Goa to the Total Marine Fish Production from 1998-2016 (Expressed in Percentages)(Qty in tonnes)

Periods	Malim	Cutbona	Vasco	Chapora	Talpona	Others
1998-2002	34.23	17.18	15.58	2.70	1.80	28.51
2002-2007	17.84	22.97	32.54	1.31	0.44	24.90
2007-2012	16.71	22.78	32.41	1.18	0.25	26.67
2012-2016	23.15	39.95	17.56	0.86	0.56	17.91
Full Period 1998-2016	**22.20**	**26.16**	**25.23**	**1.44**	**0.70**	**24.27**

Note: Others includes all the fish landing centers in North and South Goa, **Source:** Computed from the data of Fisheries Department, Government of Goa.

Cutbona jetty has the highest percentage of marine fish catch, followed by Vasco jetty, other landing centers and Malim jetty for the 1998-2016 period. Chapora jetty has 45 operational trawlers and Talpona has only two operational trawlers. Cutbona has the highest number of large size purse-seine vessels, accounting for highest percentage of marine fish catch as compared to Malim and Vasco jetties.

In table 4.11, the CAGR shows that jetty-wise marine production in Goa for the full period 1998-2016 shows positive growth for Malim, Cutbona and Vasco

Table 4.11 CAGR's Relating to Jetty-wise Marine Fish Production of Goa from 1998-2016 (in Percentages)(Qty in tonnes)

Periods	Malim	Cutbona	Vasco	Chapora	Talpona	Others	Total Production
1998-2002	-0.098	0.255	0.088	-0.262	-0.380	0.003	0.001
2002-2007	-0.034	-0.096	0.172	-0.061	-0.259	0.000	0.021
2007-2012	-0.090	0.333	-0.134	0.235	0.521	-0.049	-0.006
2012-2016	-0.011	-0.017	0.088	-0.013	-0.088	0.111	0.035
Full Period 1998-2016	**0.001**	**0.080**	**0.043**	**-0.096**	**-0.086**	**0.019**	**0.023**

Note: Others includes all the fish landing centers for marine fish catch for motorized canoes in North and South Goa, **Source:** Computed from the data of Fisheries Department, Government of Goa.

jetties and other fish landing centers in case of motorized canoes.

4.5.5 Global, National and Regional Marine Export Trend

When exports increase all sectors of the economy the primary, manufacturing and service sector also develop, leading to economic development. According to the Government of India, Department of Animal Husbandry, Dairying and Fisheries Ministry of Agriculture and Farmers Welfare, (2017) marine products have become a major foreign exchange earner. The sub-period averages reflecting comparative share of India and Goa's total marine exports to World's total marine exports are summarized in table 4.12. During the full period 1990-2017, average marine exports of world, country and Goa is showing an increasing trend. The analysis of trend shows

Table 4.12 Comparative Trends of Sub-Period Averages of Marine Exports of World, India and Goa from 1990 to 2017 (Qty in tonnes)

	Averages			Percentages		
Periods	World Exports	India Exports	Goa Exports	India to World	Goa to India	Goa to World
1990-1995	39200000	214075	9790	0.55	4.57	0.02
1995-2000	43000000	350775	10431	0.82	2.97	0.02
2000-2005	51200000	441117	10690	0.86	2.42	0.02
2005-2010	56200000	589555	23628	1.05	4.01	0.04
2010-2017	65142857	2176028	38719	3.34	1.78	0.06
Full Period 1990-2017	**52000000**	**859623**	**20138**	**1.65**	**2.34**	**0.04**

Source: Computed from the data of FAO Year book and MPEDA, data of marine exports of world for 2017 is provisional.

that liberalization had a positive impact on the country and Goa. During mid-1990's, 100 new export units were started in India. The major exporting countries of sea food products from India are Japan, USA, European Union, China, South East Asia, Middle East and others. The European Union is leading in the world marine exports. European Union is the largest buyer of marine products exports of India. The major ports in India are Pipavav, Kochi, Jawaharlal Nehru, Chennai, Vizag, Calcutta, Tuticorin, Mumbai, Mangalore, and others. The major item-wise marine products exports are Frozen Shrimp, Frozen fish, Finfish, Frozen Cuttle fish, Frozen. Squid, Dried items, live items, chilled item and others.

During the financial year 2015-16, India's marine exports were ₹ 30,420.83 crore which is about 0.9% of the National Gross Domestic Products (GDP) and 5.17% to the agriculture GDP for 2015-16 (MPEDA, 2016). The marine exports of India during the fiscal year 2015-16 were 945,892 tons in quantity and in value ₹ 4.69 billion $ dollars. It equaled about 18% of export earnings from the agricultural sector until 2017. In India, shrimps form an important component of the marine fisheries and the major item of exports. Since early 1960s, Indian shrimps have found a place in the export market fetching a substantial foreign exchange. High demand for shrimps in the international market, has led to the indiscriminate exploitation of all the shrimp species. In 2017, in the global trade, India ranked second in aquaculture production, third in marine fish production and 5th in marine exports.

The most important species of penaeid shrimp caught along Goa coast is scientifically known as "*Metapenaeusdobsoni*". It is popularly known as solar shrimp, which fetches high price in the export market. The solar shrimp is very important species both to the traditional and mechanized sectors in Goa as a source of income as well as to the export industry. These species are mostly available during the peak season from August to November. However, its harvesting is facing challenging problems of sustainable exploitation and management. As per table 4.12, the share of India to the world for marine exports shows an increasing trend, but the share of Goa's marine exports to the world is not showing a constant trend. The share of Goa to the world was stable till 2005, but registered an increasing trend for 2005 to 2017 period.

Table 4.13 shows a positive growth in marine exports of the world, India, and Goa for the full period 1990 to 2017. The share of India to the world marine exports measured in terms of CAGR shows 4% growth in the full period and has consolidated its position after liberalization since 1990-1995 registering 17% growth compared to the later periods. It is also evident that the CAGR for Goa's share to India is 8% and Goa's share to World is 5% for the full period. The CAGR of Goa to India and Goa to the World declined during 1995-2000 and 2010-2017 periods. The marine exports

Table 4.13 CAGR's Relating to Marine Exports of World, India and Goa from 1990 to 2017 (Qty in tones)

Periods	World	India	Goa	India to World	Goa to India	Goa to World
1990-1995	0.039	0.218	0.331	0.172	0.093	0.281
1995-2000	0.034	0.072	-0.026	0.036	-0.091	-0.058
2000-2005	0.038	0.012	0.093	-0.025	0.080	0.053
2005-2010	0.009	0.073	0.274	0.063	0.188	0.263
2010-2017	0.09	0.05	0.02	0.03	-0.03	-0.06
Full Period 1990-2017	**0.04**	**0.08**	**0.09**	**0.04**	**0.08**	**0.05**

Source: Computed from the data of FAO Year book and MPEDA, data of 2017 is provisional.

industry faced global economic challenges in 1997. These marine products of India were rejected by the European Union and Japan, because of quality standards and also by the United States because of anti-dumping duties. The US adopted United States Food and Drug Administration regulation on Indian markets which affected productivity and profitability of Indian Exporters. European Union countries stress on strict hygiene standards and quality assurance, right from the fish catch, storage, processing, packaging till the finished product reaches the end product. The inadequate infrastructure, processing, packaging, grading facilities, hygienic practices affected India's marine exports. However, since 1997, India adopted international standards on food safety managements such as the Sanitary and Phytosanitary measures (SPS) and Hazard Analysis and Critical Control Points (HACCP) along with agreement on technical barriers to trade which is a non-tariff barrier to marine exports. The Government of India also improved standards of the marine export processing plants in India, in order to increase exports of marine products. Presently, all the sea food export companies in India follow sanitary and phytosanitary standards laid down by the European Union while exporting marine products. In recent years, sea food industry has changed from exports of marine raw material to exports of high value added marine products leading to an increase in exports thus contributing to the increase of the much needed foreign exchange.

4.5.6 Goa's Marine Production and Exports

The marine exports from Goa comprise of different marine species such as Fresh Prawns (shrimps), Fresh Cuttle fish, Fresh Squids, Fresh Tuna, Ribbon fish, Indian Mackerals, Reef cod, Fresh Seer fish, Fresh Assorted fish, other fishes and dried fish. Table 4.14 depicts that Goa has exported almost 22.68% of the total marine fish production through the Mormugao Port Trust for the period 1990 to 2017. The

Table 4.14 Sub-Period Averages, Percentages and CAGR's of Goa's Marine Production and Exports from 1990-2017 (Qty in tonnes)

	Average			**Compound Growth Rate** (in Percentage)		
Periods	**Exports**	**Marine Production**	**Exports/Production (Percentage)**	**Export**	**Production**	**Exports/ Productio n**
1990-1995	9790	90115	10.86	0.33	0.02	0.31
1995-2000	10431	75178	13.87	-0.03	-0.09	0.07
2000-2005	10690	81637	13.09	0.09	0.10	-0.01
2005-2010	23628	88806	26.61	0.27	-0.03	0.31
2010-2017	38719	102661	37.71	0.02	0.06	-0.03
Full period 1990-2017	**20138**	**88789**	**22.68**	**0.09**	**0.01**	**0.07**

Source: Computed from various issues of Marine Products Export Development Authority (MPEDA), Cochin, Government of India, Goa Economic Survey, Govt. of Goa, data of 2017 is provisional.

percentage of exports to the marine production from 1990 to 2017 in quantity terms is showing an increasing trend. The percentage of marine exports to marine production in quantity has increased from 10.86% in 1990-1995 periods to 37.71% in 2010-2017 respectively. A highest percentage of exports to production is observed during 2010 to 2017 with 37.71%. An average marine exports from Goa from 1990 to 2017 in terms of quantity is showing an upward trend, but average marine production is not showing a constant trend for the period 1990 to 2017. According to Salim, Safeena, & Athira, (2015) if the fish landings increase the exports also increase. Goa exports marine fish products to countries such as South East Asia, China, Middle East, European Union, Japan, USA and other countries. Since 1990 till 2005 there is a marginal increase in percentage of exports but since 2005 to 2010 the exports percentage increased almost twice. The CAGR of exports is highest during 1990-1995 followed by 2005-2010. However, the growth of exports is negative in 1995-2000. The CAGR of marine production is highest during 2000-2005 periods followed by 2010-2017 due to an increase in number of motorized canoes and mechanized vessels. The highest average marine production is observed during 2010-2017 period. The CAGR of marine production is negative for 1995-2000 and 2005-2010 periods. The overall CAGR of marine production has increased from 0.02% in 1990-1995 to 0.06% in 2010-2017. The CAGR of marine exports to production ratio for full period is positive i.e 0.07%. However, the CAGR is negative during 2000-2005 and 2010 to 2017 periods.

Exports in terms of quantity and value have grown at a faster rate than marine production in Goa. Driven by demand in the international market, Goa's fish trade continues to expand year after year. According to Monteiro (2015) demand for fish in the export market as well as in value terms has increased and the export industry of Goa has done well over the years. It is hypothesized that "*There is significant growth of marine exports, marine production, and marine exports to production ratio from 1990 to 2017".* The null hypothesis proposed is "*There is no significant growth of marine exports, marine production, and marine exports of Goa to production ratio in terms of quantity from 1990 to 2017".*

Table 4.15 indicates that the growth of CAGR of marine exports showed highest growth of 8% and ratio of exports to production depicts growth of 7% statistically significant at 1% level of significance and marine production growth of 1% statistically significant at 5% level of significance. In 2014, the total marine fish production in Goa in terms of quantity touched 1,28,107 tonnes, which is a highest catch for the last ten years. Out of this, productions of 40,365 tonnes were exported in the same year bringing in revenue of ₹ 51,195 lakhs. The decrease in fish catch for some years in Goa is attributed to climatic changes, over fishing, pollution, exploitation of the offshore grounds by the bigger vessels with high speed boats, along with illegal fishing such as LED fishing and bull trawling banned by the government. There is a huge domestic consumer demand for fish and fish-related products. However, the export industry is facing many constraints like unavailability and exorbitant price of raw material, high cost of production, high cost incurred to meet the quality standards of importing countries and rejection of exports.

Table 4.15 CAGR's using Semi-log Regression Model of Goa's Marine Fish Production and Exports from 1990-2017 (Qty in tonnes)

Variables	Regression Equation	Compound Growth Rate (Percentage)	*t-value*	Sig
Marine Exports	Log Y=8.61+0.07Xt	8.00	8.45	0.00**
Marine Production	Log Y=11.24+0.01Xt	1.00	2.37	0.02**
Exports/Production	Log Y=1.97+0.06Xt	7.00	7.48	0.00**

Note: * Variable significant at 1%, ** significant at 5% level of significance, **Source:** Computed from various issues of Marine Products Export Development Authority (MPEDA), Cochin, Government of India , Goa Economic Survey and Department of Fisheries, Govt. of Goa.

4.5.7 Destination-wise Marine Exports of Goa

Table 4.16 depicts changing composition of Goa's marine exports and ranks in an order of their relative significance over varying periods and the full period. From the available data it is possible to analyze the extent of diversification of international

Table 4.16 Changing Ranks of Goa's Marine Export Markets at Varying Periods
(1st Rank =Country with largest export market share and 7th Rank =lowest market share)

Period / Countries	1995-2000	2000-2005	2005-2010	2010-2017	Full Period 1995-2017
South East Asia	1	2	1	1	1
China	2	1	2	2	2
Middle east	3	3	5	6	5
European union	4	5	6	5	6
Japan	5	4	3	4	4
USA	6	7	7	7	7
Other Countries	7	6	4	3	3

Source: Computed from the data of Marine Products Export Development Authority (MPEDA), Cochin, Government of India.

market for Goa's marine exports for the period 1995-2017. Among other importers, South East Asia, has maintained its relative importance as the largest importer of Goa's marine exports consecutively from 1995-2000 and from 2005-2017. However, only during 2000-2005, South East Asia was in second position, and China took over the first position. China has taken the second position from 1995-2000 and from 2005-2017. Middle East countries ranked third as an important market from 1995-2005 but lost its significance since 2005-2017 period by occupying 5th and 6th position respectively. The European Union was in the 4th position 1995-2000 which later lost its market share from 2000-2017 periods. Japan attained the 5th position from 1995-2000, but since 2000-2017, has been ranked in the 4th position improving its market share. USA had 6th position in 1995-2000, but lost their market shares since 2000 onwards and is being placed in the 7th rank. The other countries which were ranked in the 7th position in 1995-2000 has improved its market share and moved to 3rd rank. During the 2010-2017 periods, countries such as South East Asia have retained their position in the market share. However, other countries share has improved to the 3rd position over the period 1990-2017.

Table 4.17 Destination-wise Marine Exports of Goa from 1995-2017
(Sub-Period Averages of Relative Percentages) (Quantity in tons)

Countries / Periods	Japan	USA	European union	China	South East Asia	Middle East	Others Countries	Total
1995-2000	6.98	1.09	9.04	30.99	39.78	11.74	0.38	100
2000-2005	3.54	0.21	0.50	50.54	30.22	14.75	0.24	100
2005-2010	11.77	0.02	0.54	30.42	47.91	0.86	8.48	100
2010-2017	1.07	0.02	0.67	9.68	81.49	0.60	6.47	100
Full Period 1995-2017	**4.21**	**0.17**	**1.61**	**21.02**	**63.98**	**3.57**	**5.45**	**100**

Source: Computed from the data of Marine Products Export Development Authority (MPEDA), Cochin, Government of India.

Table 4.17 shows the sub-period average of destination-wise marine exports of Goa, and reports that South East Asia is the major market for Goa's marine exports and retained the highest relative percentage share of 63.98%, followed by China, other countries, Japan, Middle East, European Union and USA. China had a market share of 21.02%. However, in case of China, there was a drastic fall from 30.42 % in 2005-2010 to 9.68% during the period 2010-2017. The market share of other countries has improved, but the share of USA has fallen drastically from 1.09% in 1995-2000 to 2% in 2010-2017 periods.

The CAGR computed in table 4.18 reported negative growth rate for Japan, USA and the European Union for the full period. The CAGR shows significant

Table 4.18 CAGR's using Semi-log Regression Model of Goa's Marine Export Market Destinations from 1995 to 2017 (Expressed in Percentages) (Quantity in Tons)

Period	Japan	USA	European Union	China	South East Asia	Middle East	Other countries
Full Period 1995-2017	-0.03	-0.1	-0.12	0.02**	0.07***	0.16	0.12

Note: ** Variable significant at 5%, and *** significant at 10%, **Source:** Computed from the data of Marine Products Export Development Authority (MPEDA), Cochin, Government of India.

growth rate for China, South East Asia. A positive growth rate is observed for middle east and other countries, although not significant.

As per table 4.19, the CAGR of marine exports from Goa was positive for China, South East Asia, Middle East and other countries for the full period. However,

Table 4.19 CAGR's of Marine Exports from Goa to Different Countries of the World (Expressed in Percentages) (Quantity in Tons)

Countries / Periods	Japan	USA	European Union	China	South East Asia	Middle East	Other countries	Total Marine exports to all countries
1995-2000	-0.44	-0.56	-0.31	0.17	-0.19	1.66	-0.33	-0.09
2000-2005	1.22	-1.00	-1.00	-0.06	0.06	0.53	-1.00	0.03
2005-2010	-0.19	Nil	0.00	0.06	0.59	0.07	1.49	0.29
2010-2017	-0.07	Nil	-0.20	-0.15	0.07	0.00	-0.2	0.03
Full Period 1995-2017	**-0.03**	**Nil**	**-0.12**	**0.02**	**0.07**	**0.16**	**0.12**	**0.06**

Source: Computed from the data of Marine Products Export Development Authority (MPEDA), Cochin, Government of India.

in case of USA the marine exports from Goa have declined drastically. The changing composition of relatively important market shows the changing competitiveness of marine exports in the international markets due to various factors like government policies of the concerned countries, changes in the demand for marine exports, free trade policy and liberalization of marine exports.

4.5.8 Trends in Fish Production and Marine Export Instability

Table 4.20 presents Coefficient of Variation and Coppock Instability Index of marine and inland production of world, India and Goa. The year to year fluctuation in marine and inland production and exports in terms of quantity is described as production and export instability. Instability in fish production also affects the price

Table 4.20 Sub-Period Averages of Regional and International Marine and Inland Production Instability (Expressed in Percentages) (Qty in 000 tones)

	World			India			Goa		
	Coefficient of Variation of Fish Production								
Periods	**Marine**	**Inland**	**Total**	**Marine**	**Inland**	**Total**	**Marine**	**Inland**	**Total**
1990-1995	0.06	0.15	0.08	0.06	0.12	0.09	0.12	0.15	0.12
1995-2000	0.04	0.08	0.04	0.05	0.09	0.05	0.21	0.03	0.20
2000-2005	0.02	0.10	0.04	0.03	0.08	0.05	0.18	0.13	0.17
2005-2010	0.01	0.09	0.03	0.04	0.12	0.08	0.06	0.19	0.06
2010-2017	0.15	0.07	0.12	0.04	0.17	0.12	0.17	0.15	0.21
Full Period 1990-2017	**0.13**	**0.41**	**0.20**	**0.12**	**0.47**	**0.31**	**0.18**	**0.19**	**0.20**
Coppock Instability Index of Fish Production									
1990-1995	17.74	29.98	20.23	18.74	27.33	22.63	12.96	29.27	13.81
1995-2000	3.46	20.53	9.61	10.40	23.10	17.38	29.77	12.05	28.90
2000-2005	8.26	23.54	13.64	4.74	22.21	15.34	31.32	16.31	30.76
2005-2010	3.36	23.53	12.45	14.47	24.95	21.15	14.76	22.59	15.12
2010-2017	23.94	16.30	21.62	13.38	28.21	23.74	24.06	26.96	30.54
Full Period 1990-2017	**14.91**	**25.44**	**17.74**	**13.65**	**27.18**	**21.80**	**13.75**	**17.83**	**16.44**

Source: Computed from various issues of FAO Year book, Indian Council of Agricultural Research, Economic Survey Goa and Fisheries Department of Goa, data of fish production for 2017 is provisional.

stability and consumer purchasing power. Larger coppock instability means larger fluctuations. The coefficient of variation is estimated to find out variation or fluctuation in marine and inland fish production and exports of World, India and Goa in terms of quantity. Growth and instability of marine, inland fish production has been analyzed to examine the performance of fish production of World, India and Goa (state of India) since 1990 to 2017.

The coefficient of variation shows that instability is seen to be high for world production followed by India and Goa. Both marine and inland production does not have much instability from 1990-1995 to 2010-2017 in Goa. However, slight variation is seen in the case of World and India's production. The Coppock index shows that instability was very high during 1990-1995 and 2010-2017 for world, India and Goa and relatively low during 1995-2000 and 2000-2005. While analyzing the coefficient of variation, it is found that inland production instability is higher than marine instability for the world for the full period. Similar results were observed at the national level. However, Goa's marine and inland fish production is more or less same. The coefficient of variation for total fish production shows that India has high fluctuation in fish production. When the coppock instability is measured, it shows similar results for India, World and Goa as shown by coefficient of variation for the full period. There is high instability for India's production followed by World and Goa.

Table 4.21 depicts the coefficient of variation and coppock instability for World, India and Goa's marine exports. It is generally argued that when the exports of primary products fluctuate, it affects the process of economic development and

Table 4.21 Sub-Period Averages of Regional and International Marine Exports Instability (Expressed in Percentages) (Qty in tones)

Periods	Coefficient of Variation			Coppock Instability Index		
	World	India	Goa	World	India	Goa
1990-1995	0.08	0.30	0.58	18.53	46.96	58.93
1995-2000	0.09	0.13	0.29	17.14	25.57	14.98
2000-2005	0.08	0.05	0.28	18.15	9.76	29.45
2005-2010	0.02	0.11	0.38	8.53	25.81	53.16
2010-2017	0.02	0.09	0.09	9.48	16.83	4.08
Full Period 1990-2017	**0.17**	**0.51**	**0.66**	**15.03**	**31.15**	**33.62**

Source: Computed from various issues of FAO Year book and MPEDA data of marine exports of world for 2017 is provisional.

economic growth in the developing countries. It is observed that both the coefficient of variation and Coppock index shows a decline in stability from 1990-1995 to 2010-2017. Instability in world marine exports has declined from 18.53 % to 9.48 %. For India it has declined from 46.96 % to 16.83 %, and for Goa it is 58.93 % to 4.08 % respectively. Results also show that instability is high for India (31.15 %), Goa (33.62 %) and less for World (15.03 %) for the full period.

4. 6 Summary

This chapter explores the time trends in marine, inland fish production and marine exports for the State of Goa for over more than two decades. It also brings to light contribution of the primary sector to the state's income. The fishing contribution to the primary sector shows positive growth and upward trend. However, the fishing share towards the State GSDP is declining for the full period 1990-2017. The time trends of marine and inland production of India to the world for the full period 1990 to 2017 shows that India's contribution of inland to the World is 9.19% as against 2.85% towards marine. However, Goa's share of marine production to India is 3.15% as against 0.10% towards inland. The share of marine production in terms of quantity of Goa to the world is 0.09% as compared to 0.01% in case of inland. The CAGR indicates that marine species such sardines, seer fish (kingfish) and prawns shows positive and significant growth. The jetty-wise fish catch results show that Cutbona jetty has the highest CAGR in terms of marine catch, followed by Vasco and Malim jetties. The CAGR in terms of marine exports to marine production ratio of Goa in relative terms is significant with positive growth of 7%. The major export markets for Goa's marine exports are South East Asia, followed by China and other countries, but the share of export market has declined drastically. The coefficient of variation shows that instability is high for world fish production followed by India and Goa. The Coppock instability index is higher of India and Goa and lower for the World for the full period while the coefficient of variation is the highest for Goa followed by India and lowest for the World.

Over the years, Goa's marine and inland fish production is showing a fluctuating trend but this is compensated by marine exports which are showing an upward trend in terms of quantity. It is very important to increase fish production in the state on a scientific basis and explore different aspects of fisheries in consultation with the fishermen associations/co-operative societies and the government. It is also important to analyze the immense contribution of fishermen immensely in terms of marine production to the fishing industry of Goa. An attempt is made in the next chapter to analyze the capital investments, costs, earnings and profits by the fishermen owning and operating motorized fishing canoes in Goa.

Chapter 5

An Analysis of Cost, Earnings and Profit of Motorized Canoes of Fishing Business in Goa

Chapter 5

An Analysis of Cost, Earnings and Profit of Motorized Canoes of Fishing Business in Goa

5.1 Introduction

In recent years more and more traditional fishermen have shifted to motorized fishing canoes, who used before non-motorized canoes. The Government of India helped the fishermen by implementing subsidies for motorization of fishing canoes during the seventh five year plan 1985-1990, which was implemented in all the maritime states of India. The motorized sector includes gillnets, seine nets, hooks, lines and bagnet (FRAD, CMFRI 2017). A study by Devadasan & Boopendranath (2009) shows that gill nets are widely used in non-motorized, motorized sectors for harvesting small pelagic fish such as sardines, mackerels, anchovies and small carangids. These nets are also used to catch large sized fish, such as shark, seer fish, pomfrets, skipjack, and other species that attempts to swim through the net and are caught when their head passes through a mesh size of a net. This type of gill net fishing is peculiar and is regularly done in all fishing seasons. Another type of net, the "Cast net" was used widely across India and it is a primitive type of gear. Cast net fishing is carried out by the traditional fishermen in shallow waters with a boat and a net. Another gear used for fishing is by hook and line, a low cost fishing technique used to catch high value species of fish, like Indian major carps. Gill net, hook and line are eco-friendly and help in sustainable fishing.

The Fiber Reinforced Plastic (FRP) in boat building was introduced in the late 1940's, which was used for military purposes in North America (Coackley, Y.Bryn, & Conwy 1991). The motorized canoes used in the traditional sector in Goa are locally known as "*Patthe*". These boats are made of wood or FRP and are designed for fitting with 8 and 9.9 horsepower engines. In Goa, the Department of Fisheries, allows fishermen to build or purchase the motorized fishing canoes from 26 feet to 38 feet and are also permitted to use 8 and 9.9 horsepower motor engines. Motorized canoes use the outboard motor engine to carry out fishing activities. There are various gears used by the motorized canoes in Goa. Average fish catch per canoe depends on the type of gears used by fishermen and size of canoe. Traditional fishing gear used by traditional fishermen in Goa is the beach seine, locally known as "*Rampon" or* mini-purseine net. It was introduced in the 19th century by a Portuguese priest in Goa and is operated till date. The "*Rampon"* is a shore seine of an exceptionally large size which is made by bringing together 50-200 pieces and each measure between 10-12 meters long. It is an important gear usually used during the monsoon as well as other months operated from the beach or shore. The rampon net requires 25 to 30 fishermen or even more based on the size of the fishing net for carrying out the fishing operations. "*Rampon*" fishing is common in the coastal areas of Tiswadi, Bardez, Mormugao and Salcete talukas, since the eveness of the sea bottom in those places is most favourable for operation of the beach seines. The "*Rampon"* net is a very important native gear and accounts for 60% of the total fish caught by traditional fishermen in Goa. Another fishing gear used on the motorized canoes is the "Gill net" locally known as "*Mag*" or "*Cantharis*" is a stationary passive gear and plays a major role throughout the fishing season in Goa. Gill net is used by traditional fishermen in Goa owning motorized canoes and non-motorized canoes for carrying out marine fishing activities. Different mesh sizes of gill nets are used by fishermen, permitted as per government rules, depending on the type of fish to be targeted. The gill net method is used in deep waters to a distance of seven to eight miles away from the shore. They also use the hook and line in peak fishing season to particularly catch seer fish, silver bar, skipjacks, serranus and charmenus on the Goan coast.

The economics of motorized canoes has been studied by many researchers from various corners of the world and in marine fishing states of India. Ogundiwin (2014) in a study on artisanal fishing gear and canoes in Kainji Lake lower basin in Nigeria finds that fishing gears used by artisanal fishermen are gill nets, cast nets, traps, surrounding nets, beach seines, lift nets, hook and line. The study finds that fishermen normally change their gears frequently due to seasonal variation as well as to catch different varieties of species of fish but canoe is changed after a longer duration. The fishers that earn high weekly income can afford to purchase more number of fishing gears and motorized canoes of bigger length. The fishermen in Nigeria, earned good gross income as even compared to the civil servants of the state. A study by Ünal & Franquesa (2010) in Turkey in 2002-03 on small-scale fishermen using the socio-economic indicators and economic viability finds that 56% of the small-scale fishing boats were viable and earned positive net profit. They recovered their operating costs and investment in capital assets. However, there was a threat to the livelihood for the remaining 44% small-scale fishermen who had very low income. The author suggests that the Government and industry should focus its attention on the problem of sustainability. Datta & Dan (1992) examined the cost and returns of 20 mechanized and non-mechanized gill net fishing units in West Bengal. They found that the catch per trip of a mechanized unit was higher than that of a non-mechanized unit. The relationship between capital and labour productivity of gillnet fishing shows that the gross earnings increased with an increase in investment per crew member. However, they conclude that higher investment may not always result in higher returns; sometimes even units with low investments have achieved higher returns. This is because getting fish catch is an uncertain event and hence fishing income has high variations. Selvaraj et al., (2000) used the linear regression model to study advantages of motorization, social aspects of marine fishing, income and living standards of small artisanal fishermen and found that fishing was a major source of income for the fishermen owning motorized and non-motorized canoes. Gopakumar, Sarma, & Velayudhan (1994) analyzed the impact of motorization of traditional canoes on the fish resources such as tuna and whitebait anchovies in Vizhinjam in Kerala. The authors found that there was an annual increase in the catch of tuna from 361 tonnes in 1984 in pre-motorization period to 1976 tonnes during 1994 in the post motorization period. An increase was attributed to the shifting from non-motorized canoes to motorized canoes. However, during the same period the anchovies landing decreased from 580 tonnes to 386 tonnes due to motorization.

Narayanakumar, Sathiadhas, & Aswathy (2009) analyzed the motorized and mechanized fishing units along the east coast of India by using variables such as operating cost per trip, gross revenue per trip, net operating income, capital and labour productivities. The study finds that increased cost of fishing per trip, and reduced catch, declined returns per trip which were important constraints affecting the returns from fishing. S. S. Raju (2013) made a comparative study between 75 motorized and traditional canoes in two coastal states, namely; Andhra Pradesh and Tamil Nadu for the year 2010-11. This study has shown that in both the sample states, motorized households captured more quantity of fish and prawns than the traditional canoes. The three variables, namely; the number of fishing days, distance covered in the sea and gear value were significant in determining the per kg value of the fish catch. Motorization has not only helped the fishermen in increasing the number of fishing days, and fishing operations, but has helped them in venturing into long distance for fishing and in increasing their net income. Raju, Chakravarty, & Ganesh (2017) studied the economic viability of non-motorized and motorized fishing canoes using the outboard and inboard motor in Andhra Pradesh. They found that the returns from motorized canoes using outboard was better than inboard motorized canoes. The operational cost for fuel was varying from 35% to 42% for motorized canoes. However, fishing operations by non-motorized fishing canoes were economically viable. Kemparaju (1994) in a study in Goa on small-scale fisheries sector observes that drift gillnet fishing method in Goa was significant as it exploits a higher value species of fish, such as seerfish, tunas, and sharks. Thus, the drift gillnet fishery has better development prospects in the state. According to a study by K. Narayana Kurup et al., (1987), *rampon* and gill net were the very important gears operated in Goa from 1901-1984 which contributed to 90% of the catch by the non-mechanized fishing units. In 2004, a study was conducted by Gaonkar et al., (2004) to study the costs and profits of motorized crafts in Goa. However, since 2004, the researcher has not found studies on the economic analysis of motorized canoes in Goa. The present study is an attempt to fill this research gap.

The objective of this chapter is to examine the capital investments, operating and fixed cost incurred, earnings and profits made by the fishermen owning motorized canoes across two districts of Goa for the year 2016-17. The present study focuses on assessing the economic and financial performance of motorized fishing canoes across the size groups, (26-30 feet) and (31-38 feet) and also across the two districts in Goa. For this purpose, different economic and financial indicators are used as tools of measurement. The viability of the motorized fishing canoes is indicated by their economic and financial performance. Financial viability means the ability of the project to meet all the operating costs and earn adequate returns on funds invested. The capital productivity, labour productivity, input and output ratios are used as indicators of economic performance for motorized canoes. Similarly, the financial performance is assessed through rate of return on investment (ROI) earned by fishermen on motorized canoes. The economics of motorized fishing canoes is studied under the different heads, namely; fixed capital investments, fixed costs, operating costs, earnings, gross and net profit of the motorized fishing canoes in Goa. Attempts were made in the present study to estimate profits of the motorized canoes from the costs and earnings from motorized fishing business for 2016-17.

A costs and return analysis of motorized fishing canoes help the fishers to understand whether they can attain profits despite increasing operating costs. Another research question involved in the present study is that whether there is a variation in costs and profits among different categories of motorized canoes (means 26-30 feet using 8 horsepower and 31-38 feet using 9.9 horsepower engines) operational in Goa. The third query involved in this study was whether variations in costs and profits of motorized canoes are due to differences in the input combinations and earnings. Variations in the quantity of catch, species of fish catch, and changes in the price of fish determine profitability of the fishing units. An economic evaluation is needed to find out whether an increase in the total cost of fishing for motorized canoes is compensated by fishermen from gross revenue earned from fish catch. Keeping this in mind, the present study, attempts to make an assessment of the costs, earnings and profits of motorized fishing canoes in Goa operated across six talukas, namely; Tiswadi, Bardez, Pernem, Mormugao, Salcete, and Canacona. The research study attempts to investigate whether fishing business of motorized canoes are economically feasible for the fishers in Goa. The findings of this investigation would provide better insights to understand baseline status and for the government to formulate policy options for sustainable marine fisheries. It is against this background, this study looks at the economic and financial performance of motorized canoes as they have a say in the fishing industry of Goa.

5.2 Data Sources and Techniques

The study uses primary data collected through simple random sampling method using an interview schedule administered to 140 traditional fishermen owning motorized fishing canoes in North and South Goa, in the six coastal talukas namely; Tiswadi, Bardez, Pernem, Mormugao, Salcete and Canacona respectively. The interview with the fishers in these talukas helped in the collection of primary data regarding commercial and economic aspects of motorized fishing canoes.

5.2.1 Sample Size and Classification of Motorized Fishing Canoes

In the table 5.1, the sample consists of fishermen owning motorized fishing canoes in Goa. These motorized canoes are fitted with outboard engines and use the

Table 5.1 Sample Size for Motorized Canoe Owners

Taluka	Operational Motorized Canoes Population	Respondents owing the Motorized Canoes Sample	Percentage of operational motorized canoes surveyed
NORTH GOA			
Tiswadi	170	25	14.71
Bardez	177	31	17.51
Pernem	123	12	9.76
Total North Goa	**470**	**68**	**14.47**
SOUTH GOA			
Mormugao	374	42	11.23
Salcete	73	10	13.70
Canacona	193	20	10.36
Total South Goa	**640**	**72**	**11.25**
Total	**1110**	**140**	**12.61**

Note: Based on Salant & Dillman (2007) method at 10% error 50/50 split ie. upto 1000 population =88, but sample size taken is 140, (140/1110*100=12.61%), **Source:** Researchers compilation from the data of Department of Fisheries, Goa.

gill nets, and mini purse-seine nets (“*Rampon”*) method for fishing operations.

The following classification given in table 5.2 which is a basis of the present study has been prepared based on the government regulations, as regards the size of the motorized canoes, as well as after consulting the technicians and respondents.

Table 5.2 Technical and Operational Characteristics of Motorized Canoes

Size in feet	Overall Length in meters	Horsepower of outboard motor engine	Number of motorized canoes surveyed
26-30ft	8- 9.2 m	8	65
31-38ft	9.5- 11.6 m	9.9	75

Source: Researchers compilation from the primary survey.

The researcher classified the motorized canoes as given in table 5.2 to make the data collection process easy. Motorized canoes were grouped into two categories based on the overall length of the canoe and horsepower of the motor used in the canoes. In the sample, the researcher could find motorized canoes of overall length (OAL) varying from 26-38ft with engine capacities varying from 8 to 9.9 horsepower motor. In the study area, it is observed that in the recent years most of the respondents are investing in building motorized canoes from 36 to 38 feet. The 26-30 motorized canoes are fitted with one engine of 8 horsepower use a few gill nets whereas the 30-38 feet canoes use 2-3 motors and many gill nets. The mesh size of the gill net used for fish is 24 mm and depth of the gill net is 60-100 m. Variables and the statistical as well as econometric tools used in the present study for data analysis are mentioned in Research Methodology chapter in section 3.6 and 3.8 respectively.

5.3 Results and Interpretation

Empirical data on the costs and earnings i.e returns of motorized fishing canoes operating on Goa's coast in the six talukas is analyzed, and the results are explained in the forthgoing sections 5.3.1 to 5.3.8.

5.3.1 Total Number of Motorized Canoes Owned by the Respondents

Table 5.3 shows that in both the districts, majority of the respondents are having either one or two motorized fishing canoes registered in their names. In case of

Table 5.3 Taluka-wise Total Number of Motorized Canoes

Coastal Talukas	Total vessels owned per family of respondents					
	1	2	3	4	5	Total
Tiswadi	(11.4)	(6.4)	(0.0)	(0.0)	(0.0)	(17.9)
Bardez	(7.1)	(9.3)	(2.9)	(2.9)	(0.0)	(22.1)
Pernem	(5.0)	(3.6)	(0.0)	(0.0)	(0.0)	(8.6)
North Goa	**(23.6)**	**(19.3)**	**(2.9)**	**(2.9)**	**(0.0)**	**(48.6)**
Mormugao	(11.4)	(10.7)	(5.0)	(2.1)	(0.7)	(30.0)
Salcete	(4.3)	(2.1)	(0.7)	(0.0)	(0.0)	(7.1)
Canacona	(10.7)	(2.9)	(0.0)	(0.7)	(0.0)	(14.3)
South Goa	**(26.4)**	**(15.7)**	**(5.7)**	**(2.9)**	**(0.7)**	**(51.4)**
Total	**(50.0)**	**(35.0)**	**(8.60)**	**(5.70)**	**(0.7)**	**(100.0)**

Note: Figures in (parenthesis) represents percentages to the total**, Source:** Researchers compilation from the data analysis based on primary survey.

nature of ownership, most of the fishermen (98.5%) were sole owners of motorized canoes and only 1.5% have entered into a partnership. A majority of respondents (86.4%) have acquired craft through building new canoes or purchase, and only 13.6% have inherited it from their ancestors.

5.3.2 Taluka-wise Disposition of Fish Catch by Canoe Owners

Table 5.4, depicts the disposition of fish catch in Goa. The different modes of marketing are selling in the market of Goa, fish trade agents, sale by family members, sundried, salted and disposition in the form of manure. Fresh fish fetches a better price for the fishermen. In North Goa, a majority (49.60%) of the respondents family members are involved in selling in the retail markets, whereas in South Goa, majority

Table 5.4 Taluka-wise Disposition of Marine Fish Catch

Talukas	Selling in the market, and fish trade agents	Sale by family members	Sundried, salted and manure
Tiswadi	(16.50)	(16.20)	(19.20)
Bardez	(17.50)	(24.80)	(3.80)
Pernem	(7.30)	(8.60)	(19.20)
North Goa	**(41.30)**	**(49.60)**	**(42.20)**
Mormugao	(39.20)	(23.80)	(3.80)
Salcete	(7.30)	(9.20)	(34.60)
Canacona	(12.30)	(17.10)	(19.20)
South Goa	**(58.80)**	**(50.10)**	**(57.70)**
Total	**(100)**	**(100)**	**(100)**

Note: Figures in (parenthesis) represents percentages to the total**, Source:** Researchers compilation from the data analysis based on primary survey.

(58.80%) sell in the wholesale and retail market and to fish trade agents. Sundried, salting and manure options are found more (57.70%) in South Goa as compared to (42.20%) in North Goa due to more fish catch and availability of fish drying facilities.

The next discussion in section 5.3.3 on the size of the canoes and the number of labourers is important to understand the average manpower employed on different sizes of motorized fishing canoes in Goa.

5.3.3 Size of Motorized Canoes and Average Number of Labourers Employed

Table 5.5 shows that fishermen owning motorized canoes of size between 26-30 feet employ on an average two employees and 31-38 feet employ five to seven employees. Migrant employees employed outnumber Goan employees. Size of the

Table 5.5 Size of Motorized Canoes and Number of Labourers Employed

Size of Canoes	Total employees employed			Goan employees			Migrant employees		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
26-30feet	2	1	3	1	0	3	1	0	3
31-38feet	5	1	8	1	0	4	3	0	7

Source: Researchers compilation from the data analysis based on primary survey.

craft decides the labour employed on the canoes. The crew strength is a key factor that decides the fishing effort which is important for fish catch. Majority of the respondents provide medical reimbursement and other compensation benefits to the employees. Some owners also provide accommodation free of cost to the migrant employees who are employed on their canoes. All the respondents invested in corpus fund with the Fisheries Department towards the insurance policy for employees of ₹ 200 per employee per season.

The next discussion given in section 5.3.4 shows the net profit earned by the respondents from fishing business, savings and their household expenditure.

5.3.4 Net profit, Savings and Liabilities from Motorized Canoes

The Independent Sample *t*-test results in table 5.6 is conducted to understand whether there is a significant difference between the five dependent variables viz. X_1 mean of net profit of single canoe, X_2 mean of net profit from more than one canoe, X_3 mean of savings from fishing business, X_4 mean of liabilities from motorised fishing, and X_5 mean of household expenditure of the fishermen owning motorized canoes with respect to independent variable "*District*". The comparison of the mean of net profit of single canoe, mean of savings, mean of household expenditure are of 68 respondents in North Goa, and 72 in South Goa. However, the mean of net profit of more than one motorized canoe are of 36 respondents in North Goa and 35 respondents in South Goa and the mean of liabilities of 21 respondents in North Goa and 22 respondents in South Goa. The null hypothesis stated is that *"There is no significant difference between the mean of net profit of single canoe, the mean of net profit of more than one canoe, the mean savings from fishing, the mean of liabilities, and the mean household expenditure of the motorized canoe owners among districts"*. Results in table 5.6 reveal that there is a significant difference between the mean of

Table 5.6 Results of Independent Sample *t*-test of Motorized Canoes

Variables	District				Significance
	North Goa	South Goa			
	Mean (₹)	Mean(₹)	*t*-value	Sig	
X_1 Net profit of single motorized canoe	109840_a	150810_b	-5.35	0.000**	Significant
X_2 Net profit of more than one motorized canoes	242714_a	277800_a	-1.44	0.15	Not Significant
X_3 Savings from the fishing business per annum	51515_a	64306_a	-1.62	0.10	Not Significant
X_4 Liabilities of fishing per annum	92381_a	199636_b	-3.60	0.001**	Significant
X_5 Household expenditure per annum	120615_a	124972_a	0.58	0.56	Not Significant

Note: ** Variable significant at 5 %, the subscript "a, a" means there is no significant difference, whereas "a,b" means there is a significant difference, **Source:** Researchers compilation from the data analysis based on primary survey.

net profit of respondents owning single motorized canoe, (t =-5.35, p=<0.05), and mean of liabilities of respondents, (t =-3.60, p=<0.05), in the two districts. Thus, the null hypothesis is rejected. The mean difference in the net profit of single motorized canoe is more by ₹ 40,970 in South Goa as compared to North Goa and mean difference in liabilities is more by ₹ 1,07,255 in South Goa as compared to North Goa. The reason for the significant difference is that in South Goa, in the talukas of Mormugao and Salcete, a majority of the respondents have canoes of size 36 feet. Besides this, fish catch of the respondents of South Goa is higher as compared to the respondents in North Goa, due to the rich potential fishing grounds. This helps them to get more earnings, resulting in more net profit and savings as compared to respondents in North Goa. However, there are no significant differences in the mean of net profit of respondents owning more than one canoe, savings from motorized fishing business and mean household expenditure of the respondents in both the districts. Thus, from the testing of the hypothesis, it can be inferred that there are significant differences for mean of net profit of respondents owning a single fishing canoe and the mean of liabilities among the respondents of the two districts.

The section 5.3.5.1 to 5.3.5.7 gives the analysis of the sources of finance, capital investment in the fixed asset, fixed costs, operating costs, earnings and profit of the fishermen owning motorized canoes.

5.3.5 Investment, Cost and Profit Analysis for Motorized Canoes

The objective of this section is to analyse whether there are differences in the capital investments, costs, earnings and profit of the two size groups of motorized canoes. This analysis would reveal whether the differences in capital investments will affect their costs, earnings and profits from the motorised fishing business.

5.3.5.1 Sources of Finance for Motorized Canoes

The sources of finance for motorized canoes business in Goa is reflected in table 5.7, which reveals that in Goa the respondents rely on formal and informal sources to avail credit for carrying out fishing business activities. Formal sources of credit are banks, and informal sources are relatives, friends, *confraria*, fish trade, and wholesale agents. The findings show that 58 respondents i.e. (41.42%) respondents availed the loan facilities both from formal and informal sources for carrying out fishing activities and remaining 58.68% did not avail the loan facilities. Majority of

Table 5.7 Sources of Loan taken by the Fishermen Owning Motorized Canoes

District	Sources of loan					
	Bank	Family members	Relatives	Friends	Confraria	Wholesale fish trade agents
North Goa	(15.50)	(1.70)	(6.60)	(3.60)	(11.90)	(10.60)
South Goa	(25.90)	(3.40)	(2.40)	(1.40)	(3.40)	(13.80)
Total	**(41.40)**	**(5.10)**	**(9.00)**	**(5.00)**	**(15.30)**	**(24.40)**

Source: Researchers compilation from the data analysis based on primary survey. (N=58 respondents).

the respondents have availed loan from banks (41.40%), followed by wholesale agents and "*confraria*". A non-formal source of credit, locally named, "*Confraria*" is available to the fishermen subject to payment of interest. The major purpose of taking loan was to build/purchase the canoes, purchase of fishing gears (gill net and mini-purse seine net) and related fishing equipment.

As regards sources of finance, it is evident from table 5.8 that the respondents

Table 5.8 Sources of Finance for Capital Investments in Motorized Canoes

Variables	Districts			
	North Goa		South Goa	
	Size of Motorized Canoes			
Size of canoe in feet	**26-30ft**	**31-38 ft**	**26-30 ft**	**31-38 ft**
Power of the engine in the motorized canoes	**8 hp**	**10 hp**	**8 hp**	**10 hp**
	Mean	**Mean**	**Mean**	**Mean**
Hull (own money)	73575	105536	83920	114255
	(45.36)	**(51.77)**	**(46.00)**	**(57.63)**
Hull (loan money)	48333	67500	52167	51667
	(29.80)	**(33.11)**	**(28.59)**	**(26.06)**
Govt. subsidy on hull	40294	30833	46364	32317
	(24.84)	**(15.12)**	**(25.41)**	**(16.30)**
Total	**162126.84**	**203887.66**	**182525.59**	**198322.70**
	100	**100**	**100**	**100**
Outboard petrol motor (own money)	33000	33000	33000	33000
	(24.08)	**(22.04)**	**(23.78)**	**(21.85)**
Govt. subsidy on petrol motor	104050	116714	105760	118000
	(75.91)	**(77.95)**	**(76.20)**	**(78.13)**
Total	**137074.08**	**149736.04**	**138783.78**	**151021.85**
	100.00	**100.00**	**100.00**	**100.00**
Fishing gear (net own money)	85875	174643	98400	161915
	(48.01)	**(60.04)**	**(46.39)**	**(57.59)**
Fishing gear (net loan money)	64545	87333	85714	90769
	(36.09)	**(30.03)**	**(40.41)**	**(32.29)**
Govt. subsidy on fishing gear	28438	28889	28000	28444
	(15.90)	**(9.93)**	**(13.20)**	**(10.12)**
Total	**178942.10**	**290955.07**	**212200.80**	**281217.88**
	100.00	**100.00**	**100.00**	**100.00**
Safety equipment and ice box (own money)	1090	1512	1040	1583
	(32.17)	**(30.79)**	**(24.74)**	**(25.91)**
Govt. subsidy on safety equipment and ice box	2298	3399	3164	4527
	(67.83)	**(69.21)**	**(75.26)**	**(74.09)**
Total	**3420.17**	**4941.79**	**4228.74**	**6135.91**
	100.00	**100.00**	**100.00**	**100.00**

Note: Figures in (parentheses) represent the proportion of mean percentage to the total of an average of a fixed asset, **Source:** Researchers compilation from the data analysis based on primary survey.

in both the districts of Goa tend to use more percentage of own money as compared to borrowed funds for capital investment in the motorized fishing business. The government since 2013 onwards provides ₹ 60,000 subsidy per fishermen once in five years to purchase the fishing canoes, subsidy of ₹ 1,00,000 for replacement of kerosene to petrol motor in case of 8 horsepower engine and ₹ 1,18,000 subsidy in case of 9.9 horsepower engine. All the respondents have replaced their kerosene motors with petrol motors due to non-availability/shortage of kerosene in the state. The beneficiaries can operate their canoes even in bad weather conditions with the help of engine motor. The fishers can avail subsidy of ₹ 30,000 to purchase gill net once in every four years. In case of safety equipment such as life buoy, life jacket, the government gives a subsidy of 75% towards the cost of safety equipment and the balance 25% respondents invest their own money. The Government also provides agricultural loans up to ₹ 5,00,000 at 4% interest per annum for fishing activities. Many respondents have not availed this loan due to lack of awareness, interest burden as well as cumbersome formalities. It would be in the interest of the fishers, that the Fisheries Department creates awareness amongst fishermen and encourages them to take these loans for carrying out fishing activities.

5.3.5.2 Analysis of Credit Facilities

Table 5.9, depicts that almost 73.95 % who had borrowed a loan from banks had cleared their debts on time. On an average, the respondents paid the loan within

Table 5.9 District-wise Analysis of Credit taken by Fishermen Owning Motorized Canoes

Purpose of loan	District	Average number of years of loan	Average loan for the craft (₹)	Average interest amount (₹) per annum	The average rate of interest (%)	Loan paid percentage	
						Yes(%)	No(%)
Motorized canoes	**North Goa**	2	51818	5865	10.8	20.00	20.00
	South Goa	2	51867	5693	10.87	44.00	16.00
Fishing gears	**North Goa**	2	73784	8738	11.62	22.70	28.80
	South Goa	2	89697	9633	11.11	16.70	31.80

Source: Researchers compilation from the data analysis based on primary survey.

two years in order to reduce interest burden. In case of motorized canoes, 64% respondents paid the loan and in case of fishing gear, 39.40% had cleared the loan in both the districts.

The next section 5.3.5.3 to 5.3.5.7 discusses about the capital investments, fixed cost, operating costs, factors affecting motorized fishing operations and profits earned by the respondents. The results of Independent sample *t*-test across size of motorized canoes and across districts in respect of a capital investment, fixed cost, operating costs, earnings and profits, is discussed in this section. Results of Independent sample *t*-test across districts are given in the appendix Table 5A to 5E. The capital investments in fixed assets of motorized fishing canoes and other fishing equipment are important for the respondents to earn gross revenue from fishing business, which is discussed in section 5.3.5.3.

5.3.5.3 Capital Investments in Fixed Assets for Motorized Canoes

Capital investment across size of the canoes and districts is analyzed to examine whether there are significant differences among them. In the study area, of the two districts, motorized fishing canoes of wooden and fiber hulls are prevalent, but a majority (94.30%) of the fishermen own canoes of fiber hull in all the six talukas. Respondents prefer fiber hulls due to easy availability, and in case of wooden hulls, there is difficulty to get good quality wood as well as skilled carpenters. According to the respondent's views, wooden hull canoes are expensive for repair and maintenance as compared to fiber hulls. However, motorized canoes with wooden hull had an average life between 30-35 years as compared to fiber hulls which have an average life of 10-15 years, provided annual repair and maintenance is done. The total fixed capital cost of investment incurred for acquisition of motorized fishing canoes is the sum of price of the hull, petrol motor engine, cost of fishing gears, fish finder (used by canoes between 30-38 feet) and other communication equipment.

The null hypothesis stated is that "*Across the size of canoes there is no significant difference between the average capital investments in fixed assets of motorized canoes".* The independent sample *t*-test is used to examine the statistical relation of capital investment across the size of motorized fishing canoes. The dependent variable is capital investment in fixed assets, and the independent variable is the size of canoes. The same hypothesis is checked across districts and the results are given in Appendix Table 5A.

The table 5.10 presents the results of independent sample *t*-test. According to the respondent's view, during the period of the study, the price of all the gill nets along with accessories in Goa, on an average would vary between ₹ 50,000 to ₹ 1,00,000, but a mini purse-seine fishing gear would cost on an average ₹ 2,00,000 to ₹ 5,00,000, depending on the dimensions of the net. The respondents expressed that during the last ten years, the cost price of the fiber hull has escalated. Thus, cost of one motorized fishing canoe between 36 to 38 feet with all accessories and equipment would cost between ₹ 3,00,000 ₹ 5,00,000 in 2016-17. It is evident in table 5.10, that 32% to 36% of the total investment in fixed assets is spent by respondents on the hull and 50% to 58% is spent on the net itself. The analysis reveals that the cost of the

Table 5.10 Results of Independent Sample *t*-test of the Average Cost of Capital Investment in Fixed Assets against Size of the Motorized Canoes

Variables (Capital investments in fixed assets)	Size of motorized canoes		Independent sample *t*-test	
	26-30ft	31-38ft		
	Mean	Mean	*t*-value	Sig
Cost of motorized fishing canoes	89062_a **(36.37)**	119000_b **(32.24)**	-6.13	0.000**
Cost of fishing gear (net)	121769_a **(49.72)**	215600_b **(58.40)**	-10.28	0.000**
Cost of OBM petrol motor	33000_a **(13.47)**	33000_a **(8.94)**	Nil	Nil
Cost of safety equipment and ice box	1071_a **(0.44)**	1557_b **(0.42)**	-2.68	0.008**
Average of total capital investments in fixed assets	244902_a **(100.00)**	369157_b **(100.00)**	-11.70	0.000**

Note: ****Variables significant at 5%, , subscript a, b, represents significant difference and a, a, means there is no significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of an average of a fixed asset, **Source: Researchers compilation from the data analysis based on primary survey.

motorized fishing canoes and the costs of the fishing gears were the major items contributing to the total capital cost. The highest capital expenditure is incurred by the fishermen for the fishing nets, followed by the hull and petrol motor engine.

Results of the Independent sample *t*-test in table 5.10 reveal that a statistically significant relation was found between the variable hull of the canoes, fishing gear, safety equipment against the size of the canoes, and hence the null hypothesis is rejected at 5% level of significance. There is a statistically significant relation in case of the variable total capital investment in fixed asset against the size of the canoes, t (2,138)=-11.70, $p=0.00 < 0.05$, hence the null hypothesis is rejected at 5% level of significance. Reasons for these differences in capital investment in fixed assets depends on the size of the canoes, horsepower of the engine, type of fishing gears and other fishing equipment used. There is less physical strain on the fishermen due to use of engine motor. Use of engine motors helps the respondents to increase the number of fishing days and further helps the fishermen to easily reach the landing centres as quickly as possible. This helps to retain the freshness of fish catch and reduce spoilage. All the respondents spent only ₹ 33,000 and received government subsidy towards the purchase of 8 horsepower and 9.9 horsepower petrol motors. Thus, there are no statistically significant differences in the investments for petrol motor engines.

The statistical analysis of variable capital investment across size of the canoes in table 5.10 and across districts in Appendix table 5A is summarized in table 5.11.

Table 5.11 Statistical Significance of Capital Investments in Motorized Canoes

Average Capital investment in fixed assets	Size of motorized canoes	Districts
Cost of motorized canoes	Significant	Significant
Cost of fishing gear (net)	Significant	Not Significant
Cost of safety equipment and ice box	Significant	Not Significant
Total average capital investment in fixed assets	Significant	Significant

Note: Results of Independent sample t-tests for districts available in Appendix (Table No 5A),
Source: Researchers compilation from the data analysis based on primary survey.

The results of independent *t*-tests across size of canoes and across districts revealed that there are statistically significant differences in the variables, cost of motorized canoes and total average of capital investment in fixed assets, thus rejecting the null hypothesis.

Discussion on capital investment in fixed assets will not be meaningful without considering the total costs of fishing canoes classified into two categories, namely; fixed and variable costs. Fixed cost incurred by fishermen owning motorized canoes to arrive at net profit is analyzed in next section 5.3.5.4.

5.3.5.4 Fixed Costs of Motorized Canoes

In the study area, the amount incurred on fixed costs by fishermen on motorized fishing canoes includes depreciation on the assets namely; the canoes, motor, fishing gear (net), safety equipment and other accessories. Besides, depreciation, fixed costs also include net license fees, contribution towards fishermen's association and interest on the loan. The rate and method of depreciation is provided in the Research Methodology chapter in section 3.2. The results of the Independent sample *t*-test is provided in table 5.12, which shows the mean differences of fixed costs among the two size group of canoes. Similar analysis using district as a variable is provided in the appendix table 5B. The null hypothesis stated is that, *"There is no statistically significant relation between fixed costs across size of motorized canoes".* The dependent variable is fixed costs, and the independent variable is the size of the canoes. The same hypothesis is checked across districts and the results are given in Appendix Table 5B. In table 5.12 the Independent sample

Tale 5.12 Results of Independent Sample *t*-test of Average Fixed Costs as per Size of the Motorized Canoes

Variables (Fixed costs)	Size of motorized canoes		Independent sample *t*-test	
	(26-30ft)	(31-38ft)		
	Mean	Mean	*t*-value	Sig
Depreciation on canoes and motor	10716_a **(22.35)**	13313_b **(18.07)**	-5.02	0.000**
Depreciation on fishing gear(net)	30442_a **(63.47)**	53900_b **(73.16)**	-10.28	0.000**
Depreciation on safety equipment	107_a **(0.22)**	156_b **(0.21)**	-2.68	0.008**
Net license and contribution to society	1711_a **(3.56)**	1819_b **(2.47)**	-2.21	0.02**
Finance cost Interest on loan	4981_a **(10.38)**	4483_a **(6.09)**	0.39	0.69
Total average of fixed cost	47957_a **100**	73671_b **100**	-8.66	0.000**

Note: ****Variables significant at 5%, subscript a, a, represents no significant difference and a, b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of a fixed asset, **Source: Researchers compilation from the data analysis based on primary survey.

t-tests results show that the highest percentage of depreciation is incurred on the fishing gear ranging between 63-73% and on hull and motor varying between 18-22%, statistically significant at 5% level. All the variables of the fixed costs are statistically significant at 5% level, except interest on loan. This is because all the respondents have not availed loans. There is a statistically significant relation for the variable total average of fixed costs against the size of the canoes, t (2,138)=-8.66, p=<0.05, hence, the null hypothesis is rejected at 5% level of significance.

The results of Independent *t*-tests statistical analysis in table 5.12 conducted

Table 5.13 Summary of Statistical Significance of Fixed costs for Motorized Canoes

Fixed costs	Size of Motorized canoes	Districts
Depreciation on the hull and OBM petrol motor	Significant	Significant
Depreciation on fishing gear(net)	Significant	Not significant
Depreciation on safety equipment and ice box	Significant	Not Significant
Net license and contribution to society	Significant	Significant
Finance costs Interest on loan	Not significant	Not Significant
Average of total fixed costs	Significant	Significant

Note: Results of Independent sample t-tests for Jetties available in Appendix (Table No 5B)
Source: Researchers compilation from the data analysis based on primary survey.

on the factors under fixed costs against the size of the canoes and independent *t*-tests across the districts in Appendix table 5B, is summarized in table 5.13. The results in table 5.13 depicts that there are statistical differences in fixed costs among districts for the variables, deprecation on hull, motor and net license fees. However, when the total average fixed costs are considered against the size of the canoes and across districts there is a statistically significant difference at 5% significance level, rejecting the null hypothesis.

The next discussion in section 5.3.5.5 is on the variable costs (operating cost) incurred on the motorized fishing canoes when they are in operation. Operating costs is taken as a variable to arrive at the gross profit obtained from the motorized fishing business. The details of operating costs are given in the Research Methodology chapter, section 3.2.

5.3.5.5 Operating Costs of Motorized Canoes

In the present study, for variable operating costs across the two size group of canoes, the null hypothesis proposed is that *"There is no statistically significant relationship between operating costs across the two size group of canoes".* The same hypothesis is checked across districts and the results are given in Appendix Table 5C. Independent sample *t*-tests were conducted by taking operating costs as dependent variable and the size of canoes as independent variables. Table 5.14 reveals that maximum amount incurred under operating cost includes the cost of fuel, followed by wages of labour, mending of nets, marketing costs and food for labour. All the variables of operating costs are statistically significant, $t(2,138)=-14.57, p=<0.05$ at 5% significance level rejecting the null hypothesis. The operating cost is higher for 30-38 feet as compared to 26-30 feet sized motorized fishing canoes. According to respondents view, high fluctuations in the fuel prices creates instability in motorized fishing business as every fishing operation needs high investment in operating costs mostly for fuel. In the study area, respondents employ labourers to operate the fishing canoes. Motorized canoes from size 34-38 feet involved in mini-purse-seining method of fishing require on an average between six to eight labourers per canoe, per trip. Respondents owning 26-30 feet size canoes use the gill net method for fishing operations and employ on an average two to three employees per canoe. The wages paid to these employees are of a different nature. There is no concept of salary, but all the respondents pay their employees wage on percentage share basis. Under this system, respondents deduct the petrol i.e fuel expenses, from the gross revenue earned from the catch per trip. Thereafter, on the remaining net revenue, owner of the canoes and all the employees share on a percentage basis, 50% to the employees and 50%

Table 5.14 Operating Cost against the Size of the Motorized Canoes

Variables	Size of motorized canoes		Independent Sample *t* test	
	(26-30ft)	(31-38ft)		
	Mean	Mean	*t*-value	Sig
Fuel costs after fuel subsidy	112275_a **(34.16)**	223518_b **(35.56)**	-13.08	0.000**
Wages to labour	106900_a **(32.53)**	218524_b **(34.77)**	-13.31	0.000**
Food and batta	20110_a **(6.11)**	42027_b **(6.68)**	-11.59	0.000**
Cost of Ice	6498_a **(1.97)**	11969_b **(1.90)**	-5.01	0.000**
Maintenance of canoe	16118_a **(4.99)**	23813_b **(3.78)**	-5.01	0.000**
Mending nets	30150_a **(9.17)**	45665_b **(7.26)**	-8.82	0.000**
Marketing	27965_a **(8.51)**	48431_b **(7.70)**	-7.7	0.000**
Costs of baskets	5890_a **(1.79)**	11236_b **(1.78)**	-4.06	0.000**
Miscellaneous expenses	2694_a **(0.81)**	3273_b **(0.52)**	-4.04	0.000**
Total Operating cost	328600_a **100**	628456_b **100**	-14.57	0.000**

Note: ****Variables significant at 5%, subscript a, a, represents no significant difference and a, b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of an average of a fixed asset, **Source: Researchers compilation from the data analysis based on primary survey.

to the owner. A commission, locally known as "*Batta*" is paid to the employees on the catch per trip. The labourers get less percentage share of wages during lean season (December to May) and more wages during peak season (August to November).

In table 5.15, a summary of the average of operating costs shows that total average of operating costs is statistically significant across the two size group of canoes and districts. There are statistically significant differences for all elements of operating costs except in case of miscellaneous expenses across districts. Thus, when considered as a whole, operating costs has a significant statistical relation as per the size of canoes and districts, rejecting the null hypothesis. In North Goa, respondents narrated that there are dolphins which destroy the nets in Bardez taluka. In Tiswadi taluka there are rocks in the sea due to which the canoes as well fishing gears get

Table 5.15 Statistical Significance of Operating Costs Across Size of Motorized Canoes and Districts

Variables	Size of motorized canoes	Districts
Fuel cost	Significant	Significant
Wages	Significant	Significant
Food, Batta, and Ration	Significant	Significant
Cost of Ice	Significant	Significant
Repair and Maintenance	Significant	Significant
Mending Nets	Significant	Significant
Marketing	Significant	Significant
Costs of baskets	Significant	Significant
Miscellaneous expenses	Significant	Not Significant
Total of operating cost	Significant	Significant

Note: Results of Independent sample t-tests for Jetties available in Appendix (Table No. 5C). **Source:** Researchers compilation from the data analysis based on primary survey.

spoilt frequently. Hence, major share of respondent's gross income is spent on nets, repair and costs of maintenance.

The other factors which influence the net profit of fishermen are fishing trips, fishing days and fishing hours on the motorized canoes. These factors are discussed in section 5.3.5.6. which are important for fishermen to earn gross revenue.

5.3.5.6 Other Factors Affecting Operations of Motorized Canoes

The factors affecting operations of motorized canoes are fishing trips, days and hours. The null hypothesis is stated as, *"Across size of canoes there is no significant statistical relation between fishing trips, fishing days, fishing hours for entire season from August to May".* The same hypothesis is checked across districts and the results are given in Appendix Table 5D. The results of Independent sample *t*-test in table 5.16, shows the statistical relation between these variables. The dependent

Table 5.16 Results of Independent Samples *t*-test of Fishing Trips, Days and Hours for Motorised Canoes for Entire Season (August-May)

Variables	Size category of motorized canoes		Independent Samples *t*-test	
	(26-30ft)	(31-38ft)		
	Mean	Mean	t-value	Sig
Total Fishing trips	230_a	236_a	1.29	0.199
Total Fishing days	230_a	225_a	1.07	0.283
Total Fishing hours	696_a	864_b	-7.30	0.000**

Note: ** Variable significant at 5% significance level, subscript **"**a, a," means no significant difference and "a, b, "means there is a significant difference, **Source:** Researchers compilation from the data analysis based on primary survey.

variable is fishing trips, fishing days and fishing hours and the independent variable is the size of canoes. In table 5.16, fishing hours statistically significantly differ, between 26-30 feet and 31-38 feet fishing canoes, t (2,138) =-7.30, p<0.05 due to the following reasons. Due to its size, the 31-38 feet sized fishing canoes has the advantage to go for fishing on an average of 3-7 hours covering more distance as compared to 26-30 feet which venture into fishing for shorter distance on an average of 2-4 hours per day. During the post-monsoon season, the number of trips and fishing days are more from August to November due to more fish catch. However, the trips and fishing days are less during December to February, the winter season when the fish catch reduces. The number of trips and fishing days again increase during pre-monsoon season viz. April to May. However, there are no statistically significant differences in case of fishing trips and days. Field inquiries with the respondents revealed that the number of fishing days, fishing trips and fishing hours will depend on the climatic conditions, seasonal variations, festivals, labour availability, repairs to canoes, gears, motors and several other factors.

Table 5.17 provides the summary of average fishing trips, fishing days and fishing hours across size of canoes and districts. District-wise results are given in Annexure Table 5D. The size of the canoes as a variable has statistically significant relation to the number of fishing hours. Fishing trips and fishing days differ significantly between districts, whereas fishing hours does not differ significantly

Table 5.17 Statistical Significance of Average Fishing Trips, Days and Hours for Motorized Canoes

Variables	Size category of motorized canoes	Districts
Total fishing trips	Not Significant	Significant
Total fishing days	Not Significant	Significant
Total fishing hours	Significant	Not Significant

Note: Independent t-test results for Districts available in Appendix (Table No.5 D), **Source:** Researchers compilation from the data analysis based on primary survey.

between the districts. Thus, in the case of fishing trips and fishing days the null hypothesis is rejected. However, across the size of the canoes, there is statistically significant difference for fishing hours rejecting the null hypothesis.

The next section 5.3.5.7 deals with the analysis of costs and profits of the fishing business, as it is important for fishermen to understand the commercial viability from motorized fishing canoes.

5.3.5.7 Analysis of Costs and Profit of Motorized Canoes

Economic performance of motorized canoes in fishing industry depends on costs fishermen incur and the earnings from fishing business. Hence, an analysis of costs and profits would give a clear picture of the motorized fishing business in Goa.

The formulae for computation of gross revenue, gross profit, and net profit are given in the Research Methodology chapter in section 3.2 in equation 3.1, 3.2, and 3.3 respectively. The Independent sample *t*-test was conducted to find the statistical relationship between the two size group of the canoes and the districts towards costs and profit of the motorized fishing business. The dependent variables are total costs, total fish catch, gross revenue, gross and net profit per trip. The independent variables are the size of canoes and the districts. The null hypothesis framed is that, "*Across the two size groups of canoes there is no significant difference between costs, catch, gross revenue and profits per trip of motorized fishing canoes"*. The same hypothesis is checked across districts and the results are given in Appendix Table 5E.

The results in table 5.18 indicate that the fishermen operating 31-38 feet motorized fishing canoes have incurred higher total costs per trip and also get more fish catch, earn more gross revenue, gross and net profit per trip as compared to the fish catch of 26-30 feet motorized fishing canoes. Independent sample-*t* results in table 5.18 reveals that the total costs, fish catch, gross revenue, gross and net profit per trip, are statistically significant across the two size groups of canoes, at 5% significance level, rejecting the null hypothesis.

Table 5.18 Analysis of Costs and Profit Across the Size of the Motorized Canoes for the Entire Season (August-May)

Variables	Size category of motorized canoes		Independent Samples Test	
	(26-30ft)	(31-38ft)		
	Mean(₹)	Mean(₹)	*t*	Sig
Total operating costs per trip (₹)	1439_a	2752_b	-12.93	0.000**
Total fixed costs per trip (₹)	211_a	323_b	-7.18	0.000**
Total costs per trip (₹)	1650_a	3074_b	-13.11	0.000**
Total catch for entire season **(in kgs)**	4450_a	7704_b	-13.34	0.000**
Catch per trip **(in kgs)**	19_a	34_b	-11.93	0.000**
Gross Revenue (Earnings) per trip (₹)	2102_a	3747_b	-12.71	0.000**
Gross profit per trip (₹)	663_a	995_b	-9.57	0.000**
Net profit per trip (₹)	452_a	672_b	-6.98	0.000**

Note: ** Variable significant at 5% subscript" a, a" means no significant difference and "a, b" means there is a significant difference. **Source:** Researchers compilation from the data analysis based on primary survey.

Table 5.19 provides a summary of the statistical relation existing between variables related to costs, catch, gross revenue and profit per trip towards the two variables, size of the canoes and the districts. Results of the Independent sample *t*-test across districts are given in Appendix table 5E. Independent sample *t* test results in table 5.19 indicates that total costs, catch, gross revenue, gross and net profit per trip are statistically significant at 5% level of significance across the two size groups of canoes and the districts. Performance of motorized canoes in South Goa in terms of

Table 5.19 Summary of Costs and Profit Across the Size of the Motorized Canoes and Districts for the Entire Season (August to May)

Variables	Size of Canoe	Districts
Total Operating cost per trip (₹)	Significant	Significant
Total fixed cost per trip (₹)	Significant	Significant
Total cost per trip (₹)	Significant	Significant
Total catch (in kgs)	Significant	Significant
Catch per trip in kgs	Significant	Significant
Gross Revenue per trip (Earnings) (₹)	Significant	Significant
Gross profit per trip(₹)	Significant	Significant
Net profit per trip (₹)	Significant	Significant

Note: Independent t test results for Districts available in Appendix (Table No 5E), **Source:** Researchers compilation from the data analysis based on primary survey.

earnings, gross and net profit per trip is higher than North Goa as shown in the Appendix, Table 5E. Thus, from table 5.19 summary, it can be concluded that there exists statistically significant differences across size of canoes and districts for variables costs, fixed costs, fish catch, gross revenue, gross and net profit per trip at 5% significance level. Hence, the null hypothesis is rejected. The main reason is due to the differences in size of the canoes, number of labourers, type of fishing gears, number of fishing trips and fishing hours as well as the quantum of fish catch.

In the next section 5.3.6, an attempt is made to study the impact of socio-economic factors and geographic location (by districts) of fishermen owning motorized canoes in Goa on the net profit, earnings, and savings from the motorized fishing business.

5.3.6 Regression Analysis

This section examines impact of socio-economic characteristics, and geographic division (by district) of the respondents on the net profit, earnings from fish catch and the savings of motorized fishing canoes in Goa for the entire fishing season August to May. A multiple linear regression model is used to examine impact of the above-mentioned factors on the three dependent variables using two different equations. Dependent variables are net profit of motorized fishing canoes, earnings from fish catch and savings from fishing business. Independent variables are socio-economic characteristics of respondents and districts in which they operate fishing canoes. Dependent and independent variables are defined in Research Methodology chapter in section 3.6.

5.3.6.1 Impact of Socio-economic Characteristics on the Net profit, Earnings and Savings from fishing

The independent variables are $X_{1=}$ Gender of the respondents, Dummy variable Male=1 and 0 for female respondents. X_2= Caste of the respondents, Dummy variable 1=OBC and 0 for ST and general category, X_3=Educational qualification of the respondents (in years), X_4=Size of family (number of family members), $X_{5=}$Experience in fishing business (in years), X_6=Number of family members involved in fishing (number), X_7 is Financial status by position in poverty line, Dummy variable 1=APL (above poverty line) and BPL=0. There are above poverty line and below poverty line respondents owning canoes. It is hypothesized that "*Socio-economic characteristics of the canoe owners have an impact on the net profits, earnings from fish catch and the savings from motorized canoes".* While testing the multiple linear regression models, the null hypothesis, stated is that *"Socio-economic characteristics of the canoe owners have no significant impact on the net profits, earnings from fish catch and savings from the motorized canoes."* Three multiple regression equations specified are mentioned in Research Methodology in section 3.8.7.4, equation number 3.17, 3.18 and 3.19 respectively.

Multiple regression model is estimated on the basis of 140 responses. The tests revealed that age and number of years of experience in fishing business of the respondents had issues of multi-collinearity. Hence, age as a variable has been dropped from the variable for this model. Instead, the number of years of experience in fishing is used as proxy for age.

5.3.6.1.a Impact of Socio-economic Characteristics on the Net profit

The assumptions of linearity and homoscedasticity were verified by scatter plot of standardized residuals over predicted values for the multiple regression model. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multi-collinearity were also observed using variance inflation factor (VIF) values which were less than five, concluding that the assumptions of linearity, homoscedasticity and multi-collinearity are met.

The multiple regression models given in table 5.20 as equation 1 (5.1) explains the following results. The Adjusted R^2 indicates 31.70% variation in net profit is explained by the socio economic variables, whereas, 68.30% variation is determined by other factors not considered. The variables that are statistically significant at 5% significance level, are gender (p=0.000), and caste i.e. OBC (p=0.004) could

Table 5.20 Impact of Socio-Economic Characteristics of Fishermen on Net profit, Earnings and Savings from Motorized Fishing Canoes

Socio-economic variables	Equation 1 (5.1)			Equation 2(5.2)			Equation 3 (5.3)		
	Net Profits (Y_1)			Earnings from Catch (Y_2)			Savings from fishing business (Y_3)		
	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value
(Constant)	39350	1.56	0.11	256194	2.13	0.03	-44972	-1.91	0.05
X_1 *Gender* I_s *Male*	59015	4.18	0.000**	153720	2.28	0.02**	6338	0.48	0.63
X_2 I_s Caste (OBC)	30121	2.91	0.004**	263272	5.32	0.000**	30743	3.17	0.002**
X_3 *Qualification(Yrs)*	833	0.72	0.47	3257	0.59	0.55	2389	2.2	0.02**
X_4 *Size of family members (No.)*	211	0.09	0.92	6193	0.6	0.54	3762	0.65	0.51
X_5 *Experience in fishing business (Yrs)*	-123	-0.36	0.71	-1334	-0.83	0.4	301	0.96	0.33
X_6 *Family members involved in fishing business (No.)*	1474	0.24	0.81	4514	0.15	0.87	8913	4.44	0.000**
X_7 I_s *APL*	14855	1.88	0.06*	91968	2.44	0.01**	12251	1.66	0.09*
Adjusted R^2	31.70%%			43.70%			36.80%		
F-value	7.51	0.000		9.57	0.000		8.9	0.000	

Note: Variable significant at **5%, variable significant at * 10%, I_s means dummy variable, **Source**: Researchers compilation from the data analysis based on primary survey.

significantly predict the net profit, F (7,132)=7.51, p<0.05. The variable financial status by position in poverty line viz. APL is significant at 10% level (p=0.06). It is observed that there is a positive slope coefficient for independent variables, namely; gender, caste, educational qualification, and family members involved in fishing and financial status by position in poverty line and is line with the expectation. However, in case of experience in fishing business there is a negative slope coefficient and it is against the expectation and it is not statistically significant. The variable, gender i.e male respondents are showing significant difference, as out of 140 respondents, 12 are female respondents in fishing business. Male respondents carry out fishing activities, have more experience in handling the fishing business as compared to female respondents and earn higher net profit than female respondents. If a male respondent is directly involved in the fishing business as compared to a female respondent, net profit of male respondent would increase by ₹ 59,015, on an average keeping other variables constant. Female respondents have registered motorized canoes in their name, but seldom get directly involved in fishing, causing less net profit in the study area.

Further, there are ST, OBC, and general category respondents. Majority of the respondents belong to OBC (‘*Kharvi”)* category, who are traditional fishermen, and who genetically have the skills of fishing since their ancestors have been doing the fishing business for many generations. If a fisherman belongs to OBC category and is involved in fishing business, as compared to a fisherman from ST or general category, the net profit of OBC fisherman would increase by ₹ 30,121, on an average keeping other variables constant, which is statistically significant at 5% significance level. In case an APL respondent is involved in fishing business, net profit would increase by ₹14,855, on an average keeping other variables constant, which is statistically significant at 10% level. The variables, namely; educational qualification and number of family members involved in fishing do not show significant impact on the net profit. Overall results show that the three independent variables, the socio-economic characteristics, namely; gender (male), OBC caste and APL show statistically significant impact on the net profit of motorized fishing business.

5.3.6.1. b Impact of Socio-economic Characteristics on the Earnings from Catch

Impact of the socio-economic characteristics on the earnings from the fish catch is analyzed in table 5.20, equation 2(5.2). The Adjusted R^2 for the overall model in table 5.20, for equation 2(5.2) indicates 43.70% of variation in the earnings from fish catch and explained by socio-economic characteristics; namely; gender and caste, and financial status on poverty line index. However, 56.3% of the variation in earnings is determined by other factors not considered in the model. The variables that are statistically significant at 5% significance level, are gender, (male) (p= 0.02), caste (OBC) (p=0.000), and financial status on poverty line index, i.e. APL category respondent, (p=0.01) which could statistically predict the earnings from fish catch, F (7,132)=9.57, p<0.05. The F-value being significant is also an indication that the model has a good fit to justify the factors influencing fishing business in the study area. The variable gender is significant as male respondents earn higher earnings from catch as compared to females. If a male respondent is involved in fishing business compared to a female respondent, earnings from fish catch for the entire season would increase by ₹ 1,53,720 on an average keeping other variables constant, statistically significant at 5% level. If the fishermen belonging to OBC category are involved in motorized fishing business, as compared to fishermen from ST and general category, the earnings of OBC fishermen would increase by ₹ 2,63,272 on an average keeping other variables constant, statistically significant at 5% level. In case of an APL respondent engaged in motorized fishing business, the earnings would increase by ₹ 91,968 on an average keeping other variables constant, statistically significant at 5% level.

It is expected in the present study to have a positive relation for variables educational qualification and earnings, number of family members involved in fishing and their earnings. The results show that the relations are existing between them but they are not statistically significant at 5% level. However, a positive slope coefficient is observed for the variables, size of family members and earnings and is not in line with the expected results, although not statistically significant at 5% level. The relationship between the variables, experience in fishing business and earnings although was expected to be positive, however results showed negative slope coefficient which is not statistically significant at 5% significance level. The results of equation 2 (5.2) model reveal that out of all the seven socio-economic independent variables considered, three variables namely; gender (male), caste (OBC) and APL respondents are the most important variables significantly influencing earnings from motorized fishing business. Thus, if a male belonging to OBC caste and APL category enters into fishing business, there would be a statistically significant impact on the earnings of fishermen.

5.3.6.1.c Impact of Socio-economic Characteristics on the Savings

Results in equation 3(5.3) explain impact of socio-economic characteristics of respondents on the savings from fishing business. The model predicts the dependent variable and returns an Adjusted R^2 of 36.80% for the overall model. However, variables that have statistically significant impact on savings are respondents belonging to OBC caste (*p*=0.002), educational qualification (*p*=0.02), and family members involved in the fishing business (*p*=0.000) at 5% level of significance. The variable financial status by position in poverty line viz. APL respondent, (*p*=0.09) is statistically significant at 10% level of significance. These variables could statistically predict the savings, $F\ (7,132) = 5.57$, $p=<0.05$ at 5% level of significance. Hence, it can be generalized that if a respondent belonging to OBC caste category is involved in fishing business compared to ST and general category respondent, then the savings of OBC respondent would increase by ₹ 30,743 on an average keeping all other variables as constant. This is not surprising because fishermen belonging to OBC category are traditional fishermen and they have wide experience and are familiar with the techniques and skills of fishing as the fishing business is carried on by their families for generations. As a result of this, they earn more profit; naturally they are brought above the poverty line. The variable educational qualification of the respondents had statistically significant impact on the savings from fishing business. Thus, if the respondents are qualified, their savings would increase by ₹ 2,389 on an average, keeping all other variables constant, at 5% significance level. In case of variable, family members involved in fishing business, positive slope coefficient was observed and is in line with the hypothesis. The analysis reveals that if family members of the respondents are involved in fishing business, then the savings of family would increase by ₹ 8913 on an average keeping all other variables constant at 5% significance level. In case of respondents belonging to APL who are involved in motorized fishing business, their savings would increase by ₹ 12,251 on an average keeping other variables constant, at 5% significance level.

An overall summary of the socio-economic characteristics on the dependent variable savings shows that the four independent variables, namely; OBC caste, educational qualification, family members involved in fishing business, and respondents belonging to APL category have a statistically significant impact on the savings of fishermen.

In the next section 5.3.6.2 the impact of geographic location of the fishermen operating canoes on net profit, earnings and savings is discussed.

5.3.6.2 Impacts of Geographic Location (by district) on the Net profit, Earnings, and Savings

A linear regression model is used to study the impact of geographic location (by districts) of fishermen operating canoes on the net profit, earnings from catch and savings. It is hypothesized that, *"Geographic location (by districts) of the fishermen has an impact on the net profit, earnings from fish catch and savings from motorized canoes".* The null hypothesis proposed is, that "*Geographic location (by district) of the fishermen has no impact on the net profit, earnings from fish catch and savings of motorized canoes owners.*

In the linear regression**,** Y_4 is the dependent variable and it denotes net profit, Y_5 is dependent variable which denotes earnings from fish catch and Y_6 is the dependent variable that denotes savings from fishing business. The independent variable is X_1 i.e. District, (Dummy variable, South Goa =1 and North Goa =0). u_i is the residual error term assumed to have a zero mean and constant variance. There were 140 responses for this linear regression model. The variables used are given in Research Methodology chapter three in section 3.6 and the three linear regression equations in section 3.8.7.3 equation 3.13, 3.14 and 3.15 respectively. The table 5.21 presents results of the linear regression model, showing the impact of districts on net profit, earnings and savings from motorized fishing business. The assumptions of linearity and homoscedasticity were verified by the scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multi-collinearity were also observed using VIF values which were less than 5, concluding that the assumptions of linearity, multi-collinearity and homoscedasticity are met.

5.3.6.2.a Impact of Variable District on the Net Profit

The results of the linear regression model given in table 5.21 in equation 4 (5.4), shows that the independent variable district predicts net profit (dependent variable) and R^2 shows 16.90% variation in net profit. The rest 83.10% variation is determined by other factors which are not considered in the study. The district South Goa could statistically predict net profit, F (1,138) =28.09, p<0.05. The positive slope coefficient is observed for the district South Goa and is in line with the hypothesis, and is having a statistically significant impact on net profit at 5% level of significance

(p=0.000), rejecting the null hypothesis. The results reveal that if respondents owning motorized canoes are from South Goa as compared to respondents from North Goa then the net profit of the respondents from South Goa would increase by ₹ 40971 on

Table 5.21 Impact of Location viz. District on Net Profit, Earnings, and Savings of Fishermen Owning Motorised Canoes

<table>
<tr><th rowspan="3">District</th><th colspan="3">Equation 4(5.4)</th><th colspan="3">Equation 5(5.5)</th><th colspan="3">Equation 6 (5.6)</th></tr>
<tr><th colspan="3">Net Profits (Y_4)</th><th colspan="3">Earnings from Catch (Y_5)</th><th colspan="3">Savings from fishing business (Y_6)</th></tr>
<tr><th>Unstandardized Coefficient</th><th>t-value</th><th>p-value</th><th>Unstandardized Coefficient</th><th>t-value</th><th>p-value</th><th>Unstandardized Coefficient</th><th>t-value</th><th>p-value</th></tr>
<tr><td>Constant</td><td>109840</td><td>19.81</td><td>0.000</td><td>571011</td><td>21.24</td><td>0.000</td><td>515145</td><td>9.04</td><td>0.000</td></tr>
<tr><td>X_1 South Goa</td><td>40971</td><td>5.30</td><td>0.000</td><td>215578</td><td>5.75</td><td>0.000</td><td>12791</td><td>1.61</td><td>0.11</td></tr>
<tr><td>R^2</td><td colspan="3">16.90%</td><td colspan="3">19.30%</td><td colspan="3">1.80%</td></tr>
<tr><td>F-value</td><td>28.09</td><td colspan="2">p= 0.000</td><td>F-value 33.09</td><td colspan="2">p= 0.000</td><td>F-value 2.59</td><td colspan="2">p= 0.11</td></tr>
</table>

Note: ** Variable significant at 5% significance level, Constant is North Goa as the reference category**, Source:** Researchers compilation from the data analysis based on primary survey.

an average as compared to respondents from North Goa. This can be attributed to the factors that in South Goa, especially in Mormugao and Salcete talukas, fishermen are bestowed with fishing grounds devoid of rocks helping them in getting better catch. Fishermen also use bigger size canoes ranging from size 36-38 feet and more labour. They also use mini-purse seining method and "*Rampon*" nets for better catch.

5.3.6.2.b Impact of the District on Earnings

On analysis of the model in table 5.21, using the equation 5 (5.5) it can be seen that district, South Goa predicts the dependent variable and the R^2 indicates 19.30% variation in earnings, whereas, 80.70% variation is determined by other factors which were not considered in the model. The district South Goa could statistically predict the earnings, F (1,138)=33.09, p<0.05, at 5% significance level. The positive slope is observed for variable district South Goa and is in line with the hypothesis. The variable that is statistically significant at 5% level of significance is South Goa district, (p=0.000). The results show that if a respondent owning motorized canoe is from South Goa as compared to a respondent from North Goa then the earnings of the respondent belonging to South Goa would increase by ₹ 2,15,578 on an average keeping other variables constant.

5.3.6.2.c Impact of the District on Savings

The model given in table 5.21, using equation 6(5.6) shows that the variable district, South Goa could not predict dependent variable and R^2 indicates 1.80% variation in savings, whereas, 98.2% variation is determined by other factors which are not considered in this study. The variable district i.e South Goa could not statistically predict savings from fishing business, F (2,138) =2.59, p=0.11>0.05. A positive slope is observed for the district South Goa. The variable district South Goa is not statistically significant at 5% level of significance, (p=0.11) hence, failing to reject the null hypothesis. Therefore, the results indicate that respondents doing fishing business in the district of South Goa have no significant impact on savings of the fishermen. The overall linear regression results reveals that district South Goa had statistically significant impact only on the net profit and earnings and not on savings from fishing business.

The next analysis given in 5.3.7 is on the factors of production which are important in determining the output from the earnings of fish catch.

5.3.7 Factors of Production Influencing the Earnings from Fish Catch using the Cobb Douglas Production Model

In this study, Cobb Douglas production function is used to identify whether the input of factors of production have an impact on the earnings from the fish catch. Independent and dependent variables chosen for the multiple regression models in this study are defined in the Research Methodology chapter in section 3.6. In line with the review of literature, a Cobb Douglas production function using multiple linear regression model is used to examine the relationship between the input of factors of production and the output from fish catch, viz the gross earnings. The equation is defined in Research Methodology in section 3.8.7.5. equation no. 3.20 and 3.21. For the multiple linear regression model, using Cobb Douglas production function, it is hypothesized that "*There is an impact of selected factors of production on the earnings from output of fish catch".* The null hypothesis proposed is that "*The input of factors of production has no impact on the earnings from the output of fish catch."*

As per table 5.22, log-log regression model was used to fulfill the conditions of normality. Log was taken of all the independent variables in order to keep uniformity. The production function was specified as log of earnings for the output of fish catch as the dependent variable and six selected independent variables namely; log of experience in fishing, log of horsepower of the engine motor, log of the total cost of fishing gear, log of fishing hours, log of fishing trips, log of fuel cost after subsidy. There were 140 responses considered for this multiple regression. Assumptions of linearity and homoscedasticity were verified by scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All standardized residual values were within ± 3 standard deviations. There is multi-collinearity between variables fuel and wages paid to labour and hence wage is dropped as a variable, and fuel cost after subsidy is used as a proxy. The assumptions of multi-collinearity were also observed using VIF values which were less than 5 concluding that the assumptions of linearity and homoscedasticity and multi-collinearity are met. The multiple regression model is given in the table 5.22 indicates that the model F (6,133) =350.25, p<0.05, is found to be a statistically significant at 5% significance level. The coefficient of multiple determination, Adjusted R^2 for the overall model is 0.81, suggests that all the selected six independent variables included in the function jointly explain 81% variation in the

Table 5.22 Impact of Input of Selected Factors of Production on the Earnings of Fish Catch from Canoes using Cobb Douglas Theory

Variables	**Equation 7 (5.7) Log of earnings from catch**			
	Unstandardized Coefficient (Beta)	**Beta x100**	***t*-value**	***p*-value**
(Constant)	4.85	485	11.62	0.000
X_1 ln experience in the fishing business	0.01	1.00	0.98	0.32
X_2 ln horse power	0.29	29	2.92	0.004**
X_3 ln total cost of fishing gear	0.003	0.30	0.16	0.867
X_4 ln fishing hours	0.16	16	3.02	0.003**
X_5 ln fishing trips	-0.28	-28	-3.56	0.000**
X_6 ln fuel cost after subsidy	0.68	68	26.34	0.000**
Adjusted R^2	81%	***F*-value =350.25**	p=0.000	

Note: Variable significant at **5 %, ln= log, **Source**: Researchers compilation from the data analysis based on primary. survey.

dependent variable log of earnings, but only 19% variation is due to other factors not considered in this model. The negative slope coefficient is observed for variable log of fishing trips and is contrary to the expected results. It is observed that there are positive slope coefficients for variables namely; log of experience in fishing, log of horsepower of engine of motor of canoes, log of fishing hours, log of fishing gear, log of fuel cost after petrol subsidy. In the present investigation, among six independent variables, the variables that are statistically significant at 5% significance level, are log of horsepower (p=0.004), log of fishing hours (p=0.003), log of fishing trips (p=0.000), fuel cost after subsidy (p=0.000). The remaining variables too have influence on earnings, but do not have statistically significant influence on earnings at 5% significance level. It is expected in the model as per the results of equation 7(5.7) to observe a positive relationship between all the six selected independent variables and dependent variable. However, only in the case of variable log of fishing trips contrary to what is expected is observed. A negative coefficient for log of fishing trips is observed, although they are not statistically significant. This implies that for 1% increase in the log of fishing trips, there is 28.0% decrease in the log of earnings on an average, statistically significant, (p<0.05) and hence the null hypothesis is rejected. The labour cost i.e. wages, fuel costs, increase with the number of fishing trips, thus the negative impact on the earnings. Thus, increased number of fishing trips without getting sufficient catch will result in increased operational costs affecting the earnings negatively.

In case of variable log of horsepower, as expected there is a positive relation between horsepower and variable earnings. The value for variable log of horsepower, (p=0.004<0.05), is statistically significant at 5% level. It implies that by increasing the horsepower of the engine by 1%, the log of earnings on an average would increase by 29% keeping other variables constant, rejecting the null hypothesis. The existing horsepower from 8 to 9.9 has to be increased to higher horsepower by the government in order to increase the earnings of the fishermen. A positive relation is expected between variables log of experience and log of earnings, and the results are in line with the expectation, although not statistically significant at 5% level, ($p=0.32>$0.05), and hence failing to reject the null hypothesis. The findings have shown that a positive relationship exists between the variables log of fishing gear and log of earnings and it is as per the expectation, but not statistically significant at 5% level. As expected a positive relationship is found between the variable log of fishing hours and log of earnings, and it is in line with the hypothesis, statistically significant at 5% level, (p<0.05). This implies that one percent increase in the number of productive fishing hours will result in 16% increase in the log of earnings on an average, keeping all variables as constant, rejecting the null hypothesis. Therefore, as per respondents views, productive fishing hours during the peak season, that is, August to November will help the fishermen to get more fish catch resulting in more earnings. It is also expected to have a positive relation between the variables log of fuel cost after subsidy and log of earnings, and the results have shown that they are in line with the hypothesis, and log of fuel cost after subsidy is found to be statistically significant at 5% level, ($p<0.05$). This implies that one percent increase in the variable fuel expenditure on the motorized canoes will result in an increase in the earnings from the fish catch by 68% on an average keeping all other variables as constant. The operating costs incurred on fuel by the fishermen helps them to take their fishing craft for a longer distance in search of fish catch in the sea, resulting in more earnings.

The Cobb Douglas production function using multiple regression model shows that the three variables, log of horsepower of the motor, fishing hours, fuel costs has a statistically significant positive functional relationship on the log of earnings. In this model, it is found that all independent variables jointly determine the dependent variable and the model is statistically significant. Though the other variables namely; experience in fishing, and fishing gear, has a positive relationship on the output of fish catch, their impact on the log of earnings from production is not statistically significant. Thus, the Cobb Douglas production function is found to be statistically significant at 5% level. The production function analysis using Cobb-Douglas model indicated that there is ample scope for the respondents to enhance the net profit from motorized fishing business in both the districts by increasing horsepower of the motor, number of fishing hours, and the input variables such as enhancing fuel utilization.

The next discussion on ratio analysis in section 5.3.8 is important to determine the economic efficiency indicators which are important in understanding economic and financial performance of the fishermen owning motorized canoes.

5.3.8 Ratio Analysis of Economic Indicators of Motorized Canoes

The key economic indicators of motorized fishing business are estimated on the basis of cost and earnings data. The formulae's of different ratios used are defined in Research Methodology chapter in section 3.8.7.6, from equation 3.22 to 3.40. Table

5.23 gives an analysis of the ratios used to measure indicators of economic efficiency of motorized canoes with respect to the size of canoes in Goa by using the non-parametric Mann-Whitney U test. This test was used since the ratios did not follow test of normality. Dependent variables are the different ratios and independent

Table 5.23 Ratio Analysis of Economic Indicators of Efficiency Across Size of Motorized Canoes using Mann Whitney *U* test

Sl. No	Economic parameters	Size of vessel categories		Mann Whitney *U* test		Decision
		(26-30feet) 8hp	(31-38feet) 9.9hp			
		Average	Average	z	Asymp. Sig.	
1	**Input-output efficiency (Cost Ratios)**					
i	Operating cost ratio/Capital productivity (%)	67.67	73.19	-6.40	0.000**	Reject H_0
ii	Fixed cost ratio (%)	10.27	8.89	-2.16	0.03**	Reject H_0
iii	Gross/Total cost ratio (%)	77.94	82.08	-5.04	0.000**	Reject H_0
2	**Capital efficiency**					
i	Capital turnover ratio	2.04	2.36	-3.36	0.001**	Reject H_0
ii	Payback period (years)	1.72	1.74	-0.35	0.72	Fail to Reject H_0
iii	Rate of Return on investment(capital)(%)	43.75	42.02	-0.60	0.54	Fail to Reject H_0
3	**Profitability ratios**					
i	Benefit Cost Ratio (BCR)	1.29	1.22	-5.02	0.000**	Reject H_0
ii	Gross profit /Net operating income ratio(%)	32.33	26.81	-6.40	0.000**	Reject H_0
iii	Net profit ratio(%)	22.06	17.92	-5.04	0.000**	Reject H_0
4	**Catch per unit of effort and Labour Efficiency/Productivity ratios**					
i	Catch per trip (kgs)	19.38	33.68	-8.55	0.000**	Reject H_0
ii	Labour Productivity/ Catch per labour (kgs)	3142	1763	-8.83	0.000**	Reject H_0
iii	Labour Productivity (₹)(Gross revenue per labour man days)	2155	3832	-8.97	0.000**	Reject H_0
iv	Capital investment per labour (Rs)	179960	88653	-7.98	0.000**	Reject H_0
5	**Cost volume profit analysis (Marginal effeciency)**					
i	Break Even Point (%)	32	34	-1.24	0.21	Fail to reject H_0
ii	Profit Volume ratio (%)	32	27	-6.40	0.000**	Reject H_0
iii	Ratio of MOS (%)	68	66	-1.22	0.22	Fail to Reject H_0

Note: Variable significant at **5%, Mann Whitney U test is based on mean rank, Averages are used for comparison, **Source**: Researchers compilation from the data analysis based on primary survey.

variable is the size of motorized canoes. It is hypothesized that "*There is significant difference between the ratios among the different sizes of motorized canoes in Goa.* The null hypothesis proposed is that *"There is no significant difference between the* *ratios among the different sizes of motorized canoes in Goa".* The Mann-Whitney U test is based on mean rank and averages are used to compare the ratios. The results of all economic indicators assessed through ratios are given in table 5.23 and explained as follows:

1.Input-Output Efficiency (Cost ratios):

i. Operating ratio: The input-output efficiency shows that the major portion of costs is incurred for operating expenses by the fishermen owning motorized canoes. The operating ratios were significantly different across the two size groups of canoes, U=904.50, z = (-6.40), p<0.05, and hence the null hypothesis is rejected at 5% level of significance. Almost 67% to 73% on an average of the gross revenue is spent by fishermen towards operating expenses, for both the sizes of canoes. Therefore, existing results are more or less similar to the results of other studies and not deviating much from the previous study of R.Sathiadhas (1989) whose findings reveal that 72% of the gross income is spent for operating costs for motorized canoes. The capital productivity is low, since operating ratio is high.

ii. Fixed cost ratio: The fixed cost ratios were statistically significantly different between the two size groups of canoes, U=1920, z =(-2.16), p<0.05, and hence, rejects the null hypothesis at 5% level of significance. A substantial amount in the form of interest on the loan is spent on the fixed costs by the respondents resulting in higher fixed cost ratio.

iii. Total cost ratio: The total cost ratios were statistically significantly different between the two size groups of canoes, U=1230, z =(-5.04), p<0.05, rejecting the null hypothesis at 5% level of significance. The total cost percentage varies from 77% to 82% on an average. This is in line with the findings of study by R.Sathiadhas (1989) whose study shows that the gross cost ratio was 86% for motorized canoes.

2. Capital efficiency

i. Capital turnover ratio: There was a statistically significant difference between the capital turnover ratios, against the two size groups of canoes, U=1632, z=(-3.36), p<0.05, rejecting the null hypothesis at 5% level of significance. Since the capital investments made by fishermen owning 26-30 feet canoes is less as compared to the 31-38 feet canoes, it helps fishermen owning 26-30 feet canoes to recover their capital investment from gross revenue faster than 31-38 feet canoes.

ii. Payback period (in years): In the case of payback period, there was no statistically significant difference found between the two size groups of the canoes, U=2352, z =(-0.35), p=0.72>0.05, failing to reject the null hypothesis at 5% level of significance. Both the size groups of canoes are found to efficient in terms of payback period because it takes less than two years on an average to recover the initial capital investment made by fishermen on the canoes. This is in line with the results of a study by Radhakrishnan et al. (2018) which shows that the payback period was 1.5 years for motorized canoes.

iii. Return on Investment (ROI): The ROI was not found to be statistically significantly different between the two size groups of canoes, U=2294, z=(-0.60), p=0.54>0.05, failing to reject the null hypothesis at 5% level of significance. It is evident from the present study that for every Rs 100 invested; there will be a return of 43.75% on an average for (26-30feet) canoes and 42.02% on an average for (31-38 feet) canoes. This is in line with the results of the study by Radhakrishnan et al., (2018) who finds that the ROI was 40% on motorized canoes.

3. Profitability ratios

i. Benefit-Cost Ratio (BCR): In the present analysis, fishing was profitable and feasible, since the BCR recorded a value of greater than one for both size groups of canoes and are found to be commercially viable. There were statistically significant differences between BCR against the two size groups of canoes, U=1237, z= (-5.02), p<0.05, and hence, the null hypothesis is rejected at 5% level of significance. Nevertheless, the present findings of BCR was similar to the result of another study by Shajeeva (2016) who finds that the BCR for motorized canoes was 1.07.

ii. Gross profit ratio: The gross profit ratios were statistically significantly different across both size groups of canoes, U=905, z = (-6.40), p=<0.05, rejecting the null hypothesis at 5% level of significance. There is variation in gross profit among both size groups of canoes.

iii. Net profit ratio: The net profit ratio was statistically significantly different against both size groups of canoes, U=1230, z= (-5.04), p=<0.05, and the null hypothesis is rejected at 5% level of significance. In the present study, it is found that net profit percentage on sales is higher for 8 horsepower as compared to 9.9 horsepower motorized canoes. However, the percentage of net profit is varying from 18% to 22%

on an average for both size groups of canoes due to the investment factor. This analysis proved that all sizes of fishing canoes had good economic performance, as the net profit margin ratio is more than 10% which was considered as good ratio by earlier studies.

4. Catch per unit of effort and Labour efficiency ratios:

i. Catch per trip (kgs)/catch per unit of effort

The catch (in kgs) per trip or catch per unit of effort is comparably more for 9.9 horsepower canoes as the canoes are of bigger size ranging from 32 to 38 feet, helping fishermen to bring more fish catch. There was statistically significant difference in the variable catch per trip across both the size groups of canoes, U=392, z =(-8.55), p<0.05, hence the null hypothesis is rejected at 5% level of significance.

ii. Labour Productivity (Catch per labour in kgs): In terms of labour productivity, the catch per labour is more for 8 horsepower canoes as compared to 9.9 horsepower canoes. The average number of labourers employed is more on 31-38 feet canoes compared to 26-30 feet canoes. The labour productivity was statistically significantly different across both the size groups of canoes, U=322, z =(-8.83), p<0.05, hence, reject the null hypothesis at 5% level of significance.

iii. Labour Productivity (Gross revenue per man days): Labour productivity per man-day was statistically significantly different across the two size groups of canoes, U=289,z=(-8.97), p<0.05, hence the null hypothesis is rejected at 5% level of significance. The gross revenue earned by fishermen per labour with the 31-38 feet canoes is more than 26-30 feet canoes. Thus, the 31-38 feet canoes have proved to be efficient for the fishermen in terms of labour and have further scope for increasing labour on the canoes as more manpower helps in carrying out fishing operations effectively.

ii. Capital per labour: There was statistically significant difference for capital per labour against the two size groups of canoes, U=526, z = (-7.98), p<0.05, rejecting the null hypothesis at 5% level of significance. The capital invested by respondents per labour is higher for (31-38feet) canoes, as compared to (26-30feet) size canoes as these canoes require more manpower to carry out mini purse-seine fishing operations.

5. Cost volume profit analysis (Marginal Efficiency)

i.Break-even sales (percentage): The Break-even analysis is used to examine whether the motorized canoes owners can survive and sustain in fishing business. The Break-even sales percentage was not statistically significant against two size groups of canoes, U=2139, z=(-1.24), p=0.21>0.05, hence, failing to reject the null hypothesis at 5% level of significance. In the study, it was found that the respondents who own 31-38 feet canoes had a higher break-even percentage as compared to 26-30 feet canoes. The 31-38 feet have added advantage as they use 9.9 horsepower engines, bigger gill nets and mini-purse-seine nets, more manpower, which helps them to bring more fish catch as compared to 26-30 feet canoes using 8 horsepower motors.

ii. Profit volume ratio (in percentage): There is a variation of profit volume ratio among the two size groups of canoes. The profit volume ratios were statistically significantly different across the two size groups of canoes, U=905, z=(-6.40), p<0.05, and the null hypothesis is rejected at 5% level of significance.

iii. The margin of safety (in percentage): The margin of safety was not statistically significantly different against the two size groups of canoes, U=2146, z= (-1.22), p=0.22>0.05, hence, failing to reject the null hypothesis at 5% level of significance. The margin of safety is higher for 26-30 feet canoes compared to 31-38 feet canoes.

Thus, overall results of the ratios in table 5.23 reveals that input output efficiency i.e capital productivity was low due to high operating costs. Capital efficiency was high as respondents could recover the cost of investment. Profitability ratio was high as the respondents earned reasonable profit from the business. Labour efficiency was high as they got sufficient catch by employing labour. Marginal efficiency was high as all fishing canoes surpassed the break even sales and achieved the margin of safety. The findings reveal that both 8 and 9.9 horsepower canoes owners were running into profits for the period 2016-17, hence the business was viable. However, performance of 31-38 feet motorized canoes was comparatively better in terms of rate of return on investment, catch per trip, labour productivity (sales per man-day) and break even percentage. Performance of 26-30 feet canoes was better in terms of total cost effectiveness, benefit-cost ratio, gross profit ratio, net profit ratio, capital per labour, profit volume ratio and margin of safety percentage. Field enquiries from the respondents revealed that there is uncertainty in the fishing business due to depletion of marine resources as none of the fishers are sure about the quantity of fish catch. A few respondents were leaving their traditional occupation and venturing into water sports and other fishing related activities as they could not recover the operating costs from fishing activities.

5.4 Summary

This chapter introduces the study by examining the capital investments, costs earnings and profit of 140 respondents owning motorized canoes in the six talukas of Goa during the fishing season August to May 2016-17. The study was carried out to examine the economic efficiency of the motorized fishing business. An analysis of costs and returns indicates that there is variation in capital investments, costs, earnings and profits across the two size groups of canoes, namely 26-30 feet and 31-38 feet and also across the two districts of Goa. The findings of the study also show that total costs ratio ranges between 67-73% for both sizes of canoes. The study also finds that fuel costs are a major component of the total operating costs ranging between 32-35% for both size groups of canoes. It is evident from the study, that respondents invest the highest amount on the mini purse-seine nets, gill nets followed by the hull. Depreciation on the canoes is a major element of fixed costs for the canoe owners.

The study estimated the multiple regression models and the results indicated that all the socio-economic characteristics selected did not have a significant impact on the dependent variables. However, only the independent variables namely; gender ie male, caste OBC and APL category respondents had significant impact on net profit. The socio-economic characteristics such as gender, caste viz. OBC and financial status of the respondents had significant impact on earnings from fishing business. The variables such as family member's involvement in fishing, educational qualification, caste OBC and APL category respondents had an impact on the savings from motorized fishing business. The variable District, South Goa also had an impact on the net profit, and earnings. However, this variable had no impact on savings from fishing business. It could be concluded that motorization has helped to improve the socio-economic conditions of the fishermen in the study area.

The Cobb Douglas model indicates that the variables, namely; horsepower of motor, fishing hours, and fuel cost after subsidy had a positive significant impact on earnings from the fish catch. According to the results of this model, the production function using Cobb Douglas model shows that there is ample scope for the respondents to increase earnings from the fishing business by enhancing the variables horsepower of the motors used in the canoes, increasing fishing hours, as well as fuel consumption for fishing activities.

The analysis of economic and financial indicators of motorized canoes shows that earnings from fishing are economically rewarding and profitable. The findings of the study suggest that fishing canoes of 26-38 feet in Goa are economically and financially viable and generate reasonable revenue to cover fixed and variable costs. The results reveal that both the size group of canoes get sufficient gross profit and net profit and generate sufficient funds for reinvestment. However, a high percentage of operating costs is compensated by the respondents only through the continuing increase in the fish prices. Majority of the canoes are of size 36 feet in the study area. It is economical for the respondents to invest in large sized motorized canoes between 36 to 38 feet since these canoes have the capacity to face adverse climatic conditions, have more space to store ice and fish, can carry more fuel, accommodate more labourers, thus helping them to bring more catch, that would result in earning more profits. Motorized fishing units have created employment opportunities in the marine villages to people directly and indirectly as compared to non-motorized units.

This chapter provides a holistic view of the commercial aspects of motorized canoes in the fishing business in Goa. But this study would be incomplete without studying the commercial aspects of mechanized fishing trawlers, as these contribute immensely to the marine production and exports of the fishing industry of Goa. In the next chapter six, the analysis of cost, earnings and profits of the trawlers in the fishing business in Goa is discussed.

Chapter 6

An Analysis of Cost, Earnings and Profit of Trawlers of Fishing Business in Goa

Chapter 6

An Analysis of Cost, Earnings and Profit of Trawlers of Fishing Business in Goa

6.1 Introduction

The evolution of trawling in the fishing fleet was from 14th to 19th and 20th century. Trawlers are mechanized fishing vessels and were first developed by the British in the 17th century. The modern trawlers were first built in the 19th century at Brixham. Trawling all over the world has developed due to technological advancements, which has brought in high speed horsepower engines, with more capacity, efficient navigational, communication and fish finding equipment. In India Cey-on Company carried out exploratory trawling in the seas between India and Ceylon during (1906-07) period. Trawling started in India, during the early sixties, at Cochin and later it spread to other parts of the country. The Food and Agricultural Organization (FAO) designed small and medium mechanized crafts for trawling in India between 1956 to 1961 period. Trawling is an effective method to catch different species and sizes of fish at the same time (Dineshbabu et al., 2013). A trawler can use more than two nets at the same time to carry out fishing activities. The trawl net is an active fishing gear which the mechanized boat pulls and hence it is called trawling. Mid water trawling is when the net is somewhere in the water column and bottom trawling means when the net is dragged along the bottom trawl. The trawl net is an important marine fishing gear and nearly 20% of the marine fish catch in the world is caught by the trawl gear (Sawant & Mohite, 2016). The introduction of trawl nets in the fifties helped to change the fishing pattern and production trends in India (Kurian, 1965); (Mohan Joseph & Jayaprakash, 2003).

The economic performance of trawlers in Nigeria is assessed through economic indicators such as input and output analysis (El-Naggar, Nasr-Alla, & Kareem, 2008). Financial performance of the trawlers in Saki East Oyo state in Nigeria is assessed through the rate of return on investment (Tunde, Mp, Oladipo, & Olasunkanmi, 2015). The economic sustainability of trawlers in Gujarat was studied by Sehara (1998) using ANOVA technique and exponential growth function. The study submits that trawling makes up for the higher quantity of fish catch and revenue in the post-monsoon season. Xavier (2014) in a study using multiple linear regression model finds that the economic performance of trawlers in Kerala depends on the profit they earn. The independent sample *t*-test and the one way ANOVA test was used to study total fixed costs, variable costs and earnings season-wise for small, medium and large vessels. The author used the gross profit ratio, net profit ratio and rate of return to measure profitability. The study concludes that trawl fishing units with positive gross profits and negative net profits are undergoing temporary problems and find difficult to recover their capital investments. Geetha et al., (2014) analyzed the economic efficiency of 100 mechanized gill net units and trawlers operating in Chennai by using indicators such as operating ratio, net profit, capital, and labour productivity ratios. They conclude that almost all type of fishing units on an average were running into profits as their production surpasses the breakeven point.

A study on exploratory fishing in Goa by the Government of India's fishing vessels during 1967-68 on Goa's coast revealed that it has productive trawling grounds, yielding very high catch returns of total fish per trawling hour. The study shows that Goa also has a fair proportion of some of the quality species of fish, like pomfrets and lactarius (Dorairaj & Virabhadra Rao, 1968). Sehara, Kanakkan, & Salini (1994) examined the economics of trawling on Goa's coast, by using variables such as investment, cost, income and the tool of profit and loss analysis. The authors conclude that trawlers were running in profit in Goa during 1991-1992. All the above studies show that trawling as a mechanism for improved fishing has been well established in all the maritime states of India. The above literature reviews show that no research has been conducted on the variation in capital investments, costs, earnings and profits of different sizes of trawlers in Goa. The above literature reviews revealed that a research gap was existing in the area of commercial aspects of trawling in Goa. The present study is an attempt to fill that research gap.

The trawler is locally called as "*launch*" in Goa and is widely used for trawl and gillnets operations. The Goa, Daman and Diu Fisheries rules, 1981 defines "Mechanized fishing" as "fishing by a trawler which uses mechanical power for actual fishing operations" (Government of Goa, 1981). The trawlers are bigger in size compared to the motorized crafts, and the size of the trawler can vary between 32feet to 75feet as permitted by the Government of Goa. The fishermen owning modern standard trawlers in Goa use capital-intensive technology for fishing activities. The main gear used for trawl fishing in Goa is the trawl net. Besides this, they also use the gill net. Trawl net is used to catch pelagic fish which is available at the upper layer of water and demersal fish which is available at the bottom of the sea. Gill net is used to catch fish available at mid water. During the period of the study, there 462 trawlers registered with the Fisheries Department, Government of Goa as on 31st March 2017, (Government of Goa, 2016).

The objective of this chapter is to compare and examine the capital investment, costs, earnings and profits of small, medium and large sized 78 trawler vessels across the four jetties for the fishing season August 2016 to May 2017. The objective of the study is to examine the variation in capital investments, costs, earnings and profits among different categories of mechanized trawlers (small, medium and large) owned by the fishermen in Goa. The commercial and economics of trawl fishing is studied under the different heads, namely capital investment, fixed cost, operating costs, gross revenue (earnings), gross and net profit from trawling business in Goa. This study explores the economic and financial performance of the trawlers in Goa. The economic indicators are used to assess the costs, earnings and profits of trawlers. The economic performance is an important indicator to decide the viability of the trawlers. The economic performance indicators are compared between the sizes of trawlers (small, medium and large) and across the jetties. The cost structure (comprising of capital investment, operational and fixed costs) and earnings are compared across the size of trawlers and jetties in order to examine the impact of costs and earnings on the profitability of the trawlers. The activity of trawling requires huge capital investment in fixed assets, operating costs, fixed costs and hence an assessment into the costs and profits is sufficient in the present situation to examine whether trawl fishing business is economically viable for the fishermen owning trawlers in Goa. Analysis of the viability of the trawlers will help the trawler owners, to decide whether to continue or quit the fishing business. The profitability of the trawlers is examined only by studying the costs and earnings of the trawlers operated by them for the year 2016-17.

It is hoped that this study will be useful not only to the fishermen owning trawlers to make investment decisions, but also to the government to take supporting measures for the benefit of the trawler owners. Keeping this in mind, the present study makes an attempt to analyze the cost, earnings and profit of the trawling business to understand its economic viability. So the costs, earnings and profit analysis of trawlers will help the trawler owners to understand whether they can earn profits despite high operational costs. It will also help to know whether there is a variation in capital investments, costs, earnings and profits among different categories (means different size vessels, small, medium and large) of trawlers and if so, are the variations in costs, earnings and profits of trawlers due to differences in the input combinations? It is against this background; that this study focuses on the analysis of capital investments, costs, earnings and profit of trawlers across the four jetties in the two districts of Goa, as these contribute considerably to the fishing industry of Goa. This chapter provides a detailed analysis of the commercial aspects of the trawling business in Goa and it is divided into following sections. Section 6.2 describes the data sources and research techniques, section 6.3 elaborates on the results and interpretations, and the last section 6.4 summarizes the findings.

6.2 Data Sources and Techniques

The study uses primary data collected using a structured interview schedule administered to a sample of 78 fishermen owning trawlers across the four fishing jetties situated in North and South Goa. The data was collected from the fishermen owning trawlers in the talukas namely, Tiswadi, Bardez, who operate their trawlers on Malim and Chapora jetties in North Goa. In South Goa, the two jetties from where the trawlers operate are Vasco (*Khariwada*) and Cutbona. They are situated in Mormugao and Salcete taluka respectively. The researcher covered four jetties because trawling activities are undertaken by fishermen on these four jetties. The variables used in the study are mentioned in Research Methodology section 3.6. The researcher has used analytical tools such as descriptive statistics, percentage, mean and inferential statistics. The parametric tests used are namely; independent sample *t*-test, one way ANOVA and post hoc test. The econometric tools such as linear and multiple linear regression is used to study the impact of socio-economic characteristics of fishermen owning trawlers as well as the districts in which they operate trawlers on the net profit, earnings and savings from trawling business. The Cobb Douglas production function theory is used to study the impact of input of factors of production affecting the earnings from the output of fish catch. Economic indicators are used to compare the economic efficiency of the different size trawlers using the non-parametric tests, such as Kruskal-Wallis test.

6.2.1 Sample Size and Classification of Trawlers

The table 6.1 explains the sample size of mechanized fishing vessels (trawlers)

Table 6.1 Sample Size of Mechanized Trawler Owners

Taluka and Jetty	Operational Trawlers Population	Respondents owning Trawlers Sample	Percentage of respondents owning operational Trawlers surveyed
NORTH GOA			
Bardez (Malim Jetty)	206	30	14.56
Bardez (Chapora Jetty)	41	10	24.39
Total North Goa	**247**	**40**	**16.19**
SOUTH GOA			
Mormugao Vasco Jetty (*Khariwada*)	99	19	19.19
Salcete (Cutbona Jetty)	116	19	16.37
Total South Goa	**215**	**38**	**17.67**
Total	**462**	**78**	**16.88**

Note: Based on Salant & Dillman(2007) method at 10% error 50/50 split ie. upto population 462, sample size is 53 but sample size taken in the study is 78, (78/462*100=16.88%), **Source:** Researchers compilation from the data of Fisheries Department , Goa.

used for the present study. The sample size has been scientifically calculated using the Priscilla Salant and Don A. Dillman (2007) formula.

Table 6.2 gives the technical and operational classification of fishing operations of trawlers in Goa. Xavier (2014) in a study on the economic performance of trawlers in Kerala classified the trawlers as small, medium and large. In line with the literature review, the following classification given in table 6.2 is used for the

Table 6.2 Technical and Operational Characteristics of Trawlers

Size of mechanized fishing vessels (Trawlers)	Size in feet	Overall Length in meters	No of Cylinders	Horsepower of engine	Number of vessels surveyed	Average Number of Fishing days
Small	32-36	9.8-11m	3	37-45	13	1
Medium	38-45	11.7-13.8m	4	45-70	22	1-6
Large	46-60 and above	14-18.4m	6	90-300	43	4-15

Source: Researchers compilation from the primary survey.

present study. In Goa, as per the government guidelines, the trawler owners benchmark the vessels as shown in table 6.2. The researcher also classified the trawlers into small, medium and large after consulting the technicians and respondents to make the data collection process easy. The trawlers were grouped into three categories based on the overall length of the boat, number of cylinders for vessel, horsepower of the vessel and the number of fishing days. In the sample, the researcher could find trawlers of overall length (OAL) varying from 32-60 feet with engine capacities varying from 37-300 horsepower. These trawlers are fitted with inboard engines. The maximum horsepower (hp) allowed by the Fisheries Department, Government of Goa is 300 hp. Trawlers up to 40feet cannot stay for more than 24 hours in water and cannot exploit deep sea resources. It is observed in Goa that there are small trawlers which venture for single day fishing, medium trawlers for multi-day and large trawlers for deep sea fishing. The number of days of fishing by the trawlers varies depending on the season. The depth of fishing for small trawler is 10-20m, medium is 20-60 m, and large trawler is 120-140 m. Larger size trawlers were found mostly on Malim and Cutbona jetties.

6.3 Results and Interpretation

The empirical data on the performance of mechanized fishing trawlers on the Goa's coast was analyzed, and the results are arranged in sections 6.3.1 through 6.3.8. respectively.

6.3.1 Number of Mechanized Vessels (trawlers) owned by the Respondents

Table 6.3 reveals that in both the districts, majority of the registrations are made by fishermen for single trawlers. As regards the nature of ownership, most of the fishermen were ambitious to own a trawler rather than enter into a partnership.

Table 6.3 Taluka-wise Total Number of Trawlers

Coastal Talukas	Total number of vessels owned per family of respondents					
	1	2	3	5	7	Total
Tiswadi	(7.70)	(9.00)	(3.80)	0.00	(1.30)	(21.80)
Bardez	(15.40)	(10.30)	(3.80)	0.00	0.00	(29.50)
North Goa	**(23.10)**	**(19.20)**	**(7.70)**	**0.00**	**(1.30)**	**(51.30)**
Mormugao	(16.70)	(5.10)	(1.30)	(1.30)	0.00	(24.40)
Salcete	(14.10)	(10.30)	0.00	0.00	0.00	(24.40)
South Goa	**(30.80)**	**(15.40)**	**(1.30)**	**(1.30)**	**0.00**	**(48.70)**
Total	**(53.80)**	**(34.60)**	**(9.00)**	**(1.30)**	**(1.30)**	**(100.00)**

Note: Figures in (parenthesis) represents percentages to the total**, Source:** Researchers compilation from the data analysis based on primary survey.

The respondents have experienced problems while entering into a partnership in trawling business and hence majority of them preferred to remain as sole proprietors. Most of the trawlers inherited by respondents from parents have become old and outdated. Hence, majority of them have acquired trawlers through building or purchase. The respondents also have purchased second-hand vessels and have registered them in their names.

6.3.2 Jetty-wise Disposition of Marine Fish Catch by Trawler Owners

In Goa fish is disposed through various methods. As per the table 6.4, disposition of fish catch is through marketing, salted and sundried. The preservation through salting and sun drying is done on less scale as compared to marketing. The

Table 6.4 Jetty-wise Disposition of Marine Fish Catch by Trawler Owners

Jetties	Disposition of Marine Fish Catch		
	Salted and Sundried	**Marketing**	**Total**
Malim	0.00	(38.50)	(38.50)
Chapora	0.00	(12.80)	(12.80)
North Goa	**0.00**	**(51.30)**	**(51.30)**
Vasco (*Kharivada*)	(1.30)	(24.30)	(24.30)
Cutbona	(10.30)	(24.40)	(24.40)
South Goa	**(11.60)**	**(48.70)**	**(48.70)**
North/South Goa Total	**(11.60)**	**(100.00)**	**(100.00)**

Note: Figures in (parenthesis) represents percentages**, Source:** Researchers compilation from the data analysis based on primary survey.

respondents usually sell their catch at wholesale price to all the buyers. Marketing methods involve selling of fish through auction by the trawler owners to the fish trade agents at the jetties depending on the price negotiated between them. Middlemen agents normally buy the fish catch in bulk from the respondents at the fish landing centres and sell it in other states as well as export to other countries. The other modes of marketing are selling in the wholesale and retail markets of Goa, selling by family members to the local people, transporting to other states and also exporting their highly priced catch to foreign countries through processing units. The respondents sell low priced catch and discards to fish meal plants.

The next discussion in section 6.3.3 on size of trawler and average number of labourers is important to understand the average manpower employed on different sizes of trawlers.

6.3.3 Size of Trawler and Average Number of Labourers Employed

The findings show that the fishing industry in Goa is totally dependent on migrant labour, which come from states such as Karnataka, Orissa, Jharkhand, Uttar Pradesh, and other states. Table 6.5 shows that trawlers accommodate on an average 3 to 12 crew depending on the size of the vessel. Majority of the respondents provide medical reimbursement and other compensation benefits to the employees. Most of the labourers stay on board and hence there is no necessity of providing accommodation facilities to them. All the respondents contributed towards corpus fund to the government of ₹ 200 per crew every fishing season.

Table 6.5 Average Number of Labourers Employed by Trawler Owners

Size of vessel categories	Total number of laborers			Goa's labourers			Migrant labourers		
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
Small Vessel	5	3	6	1	1	1	4	3	5
Medium Vessel	7	4	10	Nil	Nil	Nil	6	4	8
Large Vessel	8	5	12	2	2	2	9	5	13

Source: Researchers compilation from the data analysis based on primary survey.

The next analysis given in section 6.3.4 depicts the net profit earned from trawl fishing business, savings and consumption pattern of the respondents.

6.3.4 Net Profit, Savings, and Liabilities of Trawlers Fishing Business

The Independent Sample *t*-test was conducted to understand whether there is a significant difference between the five dependent variables, namely, X_1 net profit of fishers owning single trawler, X_2 net profit of fishers owning more than one trawler, X_3 savings from fishing business, X_4 mean of liabilities from trawling business, and X_5 annual household expenditure. The independent variables are the two districts. As many as 22 respondents in North Goa and 14 respondents in South Goa own more than one trawler. Respondents owning single trawler were 40 in North Goa and 38 in South Goa. The null hypothesis stated is that *"There is no significant difference between the mean of net profit of fishers having only single trawler, the mean of net profit of fishers having more than one trawler, mean savings from fishing, mean of liabilities, and mean household expenditure of the trawler owners among districts".*

The results in table 6.6 reveal that there is a significant difference between the mean of net profit in case of respondents owning single trawler (t=1.94, p=0.05<0.10) rejecting the null hypothesis at 10% level of significance. There is also significant difference between the mean household expenditure of the respondents in both the districts (t=2.35, p=0.02<0.05) rejecting the null hypothesis at 5% level of significance. The mean difference in the net profit of single trawler is more by

Table 6.6 Results of Independent Sample *t*-test of Net Profit, Savings and Liabilities of Trawlers

Variables	Districts		Independent sample		
	North Goa	South Goa	*t* –test		
	Mean (₹)	Mean(₹)	*t*-value	Sig	Significance
X_1 Net profit of single trawler	744583_a	576296_a	1.94	0.05*	Significant
X_2 Net profit of more than one trawler	1452272_a	1150000_a	1.32	0.19	Not significant
X_3 Savings from fishing p. a.	286625_a	231053_a	1.39	0.16	Not significant
X_4 Liabilities from fishing business p.a	494615_a	619231_a	(-)0.51	0.60	Not significant
X_5 Household expenditure p.a.	271925_a	232421_b	2.35	0.02**	Significant

Note: **Variable significant at 5 %, * significant at 10%, subscript "a,a" means there is no significant difference, whereas "a,b" means there is a significant difference, Net profit is from August to May, **Source:** Researchers compilation from the data analysis based on primary survey.

₹ 1,68,287 in North Goa as compared to South Goa and mean difference in household expenditure is more by ₹ 39,504 in North Goa as compared to South Goa. The reasons attributed to the differences could be respondent's income, size of the family members and standard of living. However, there are no significant differences in case of variables, net profit of more than one trawler, savings from fishing business and liabilities from fishing business in both the districts. The Government could intervene through the Fisheries Co-operative societies and self-help groups to encourage small savings among the fishermen.

The analysis on commercial, economic and financial aspects such as investment in capital assets, costs incurred, earnings and profits earned by the fishermen owning trawlers is discussed in the section 6.3.5.

6.3.5 Investment, Cost and Profit Analysis of Trawling Business

The analysis of capital investment, cost and profit of different sizes of trawlers helps to understand whether there are differences in the capital investment. The analysis also would reveal whether these differences would affect their costs, earnings and profits from fishing business. To analyze the investments, cost and profits, it is important to explain the sources of finance, investment in the fixed asset, fixed and operational costs, earnings and profits of the trawlers from sections 6.3.5.1 to 6.3.5.7 respectively.

6.3.5.1 Sources of Finance by Trawler Owners

Finance is very important to start and to sustain in any business. The sources of finance for trawling business in Goa are reflected in table 6.7. It shows that in Goa the respondents rely on formal and informal sources to avail credit for carrying out

Table 6.7 Sources of Loan taken by the Trawler Owners

Jetties	Sources of loan			
	Bank	Relatives	Friends	Agents
Malim	(34.30)	(7.50)	(3.00)	(23.90)
Chapora	(6.00)	(10.40)	(1.50)	(4.50)
North Goa	**(40.30)**	**(17.90)**	**(4.50)**	**(28.40)**
Vasco (*Khariwada*)	(14.90)	(3.00)	(6.00)	(20.90)
Cutbona	(11.90)	(7.50)	1.50	(20.90)
South Goa	**(26.90)**	**(10.40)**	**(7.50)**	**(40.30)**
Total	**(67.20)**	**(28.40)**	**(11.90)**	**(68.70)**

Note: Figures in (parenthesis) indicates percentages, **Source:** Researchers compilation from the data analysis based on primary survey.

fishing activities. Formal sources of credit are banks, and informal sources are relatives, friends, and fish trade wholesale agents. The money lenders are the wholesale agents dealing in fish trade who provide finance to the respondents to meet their financial requirements. As per the results given in table 6.7, the two major sources of finance are loans from agents and banks. The survey results reveals that majority (68.70%) of the respondents have taken loan from agents, followed by banks (67.20%). However, there is marginal difference between loan taken from bank and from agents. The major purpose of taking loan was to purchase the fishing vessel, fishing gear, reconditioning of vessel, as well as incur expenses on operational and fixed costs. The respondents were of the view that timely credit is available through the non-formal sources which is unlikely with commercial banks. The respondents also stated that they need not pay interest to agents, relatives and friends and borrowing is easier from these informal sources as there are no formalities involved, unlike banks which insist on security for the loan. Usually, the respondents prefer to sell their catch to specific whole-sale agents who will in turn help them in maintaining their business by providing loans when required. The main disadvantage of taking loan from agents is that the respondents have to sell their catch only to the agents even at a lower price in order to pay the loan amount.

In table 6.8, it is evident that the respondents in both the districts of Goa tend to use more percentage of own money as compared to borrowed funds, for capital investment in the fishing business. This is mainly due to the fear of falling into debt trap. The respondents narrated that they faced difficulty in repayment of loan due to

Table 6.8 Sources of Finance of Capital Investments by Trawler Owners

Jetties	Size of Trawler	Average loan taken for capital investment on trawler (₹)	Average of own money spent on capital investment on trawler (₹)	Total
Malim	Small	182500 **(31.33)**	400000 **(68.67)**	**582500 (100)**
	Medium	500000 **(31.65)**	1080000 **(68.35)**	**1580000 (100)**
	Large	784474 **(32.14)**	1656609 **(67.86)**	**2441083 (100)**
Chapora	Small	200000 **(36.36)**	350000 **(63.64)**	**550000 (100)**
	Medium	300000 **(21.95)**	1066667 **(78.05)**	**1366667 (100)**
	Large	266667 **(23.99)**	845000 **(76.01)**	**1111667 (100)**
Vasco (*Khariwada*)	Small	175000 **(20.50)**	678571 **(79.50)**	**853571 (100)**
	Medium	300000 **(23.76)**	962500 **(76.24)**	**1262500(100)**
	Large	571875 **(30.80)**	1285000 **(69.20)**	**1856875(100)**
Cutbona	Small	250000 **(26.32)**	700000 **(73.68)**	**950000 (100)**
	Medium	433333 **(25.90)**	1240000 **(74.10)**	**1673333 (100)**
	Large	600000 **(23.86)**	1914444 **(76.14)**	**2514444 (100)**

Note: Figures in (parenthesis) represents proportion of mean percentage to the total. **Source:** Researchers compilation from the data analysis based on primary survey.

low catch, low earnings, low profits, break down of the trawler, non-availability of labour and several other reasons. Due to these reasons, in the past the respondents faced great difficulty in paying the equated monthly installments (EMI) on the bank loan. The respondents at Cutbona jetty have used the highest percentage of their own money on the fishing activity. The main reason is that they get more fish catch resulting in high earnings. Thus, they spend more percentage of their own money on capital investments as compared to their counterparts at other jetties.

6.3.5.2 Analysis of Credit Facilities for Trawler Owners

Table 6.9 shows that the respondents prefer to clear the loans taken from banks at the earliest due to the burden of interest on loan. As per the data collected most of the respondents who had taken the loans in both the districts for the purchase of vessel and other fishing equipment had cleared the loans. The Government provides loans up to ₹ 5,00,000 at 4% interest for fishing activities, but many of the

Table 6.9 Jetty-wise Analysis of Credit taken by Trawler Owners

Jetties	Average number of years of loan	Average loan for the vessel (₹)	Average interest amount (₹)	Average rate of interest (%)	Loan paid (%)	
					No	Yes
Malim	4	690800	187500	13	2.87	71.42
Chapora	3	277778	Nil	12	0	25.71
North Goa	**4**	**581471**	**187500**	**13**	**2.87**	**97.13**
Vasco (*Khariwada*)	3	383824	37000	12	6.45	48.38
Cutbona	4	500000	70875	11	12.90	32.25
South Goa	**4**	**436290**	**59583**	**12**	**19.35**	**80.63**

Source: Researchers compilation from the data analysis based on primary survey.

respondents felt that the amount is inadequate for fishing needs and the process of availing the loan itself is burdensome. The researcher is of the view that the government could make alternate arrangements of giving interest-free emergency loans to the fishermen for carrying out the fishing activities. Besides this, the provision of microloan facilities by the government will help the fishers to meet their financial emergencies. In the long run this will help the respondents to improve their income as well as their savings. It would also help them to reduce the burden of paying interest on loan taken from formal sources.

The next section from 6.3.5.3 to 6.3.5.7 discusses about the capital investments, fixed cost, operating costs, factors affecting trawling business, earnings and profits of the respondents in trawling business. Results of ANOVA test across jetties are given in the appendix Tables 6A to 6E. The capital investments in fixed assets of trawler and other fishing equipment are important for the respondents to earn gross revenue from fishing business, which is discussed in section 6.3.5.3.

6.3.5.3 Capital Investments in Fixed Assets of Trawlers

According to International Accounting Standards (IAS)-16, fixed assets are items of property, plant, and equipment engaged by a business entity in the generation of revenue. Capital assets are also known as fixed assets, which are acquired to carry on the business with a life exceeding one year. Investment in fixed assets of trawlers is very important for the respondents in the study area to carry out the fishing business activities. This is not a recurring expenditure as it is a one-time investment made to purchase the vessel. Capital investment across the size of the trawlers and jetties is considered to examine whether there are significant differences among them.

The following discussion will focus on the major elements of costs incurred in trawl fishing business. The main components of costs involved in trawling business are capital investments in fixed assets, fixed and operating costs of trawlers. The price of a trawler depends on the size of the hull, type of hull i.e wooden or steel, horsepower of the engine and the technological equipment used for fishing activities. The fishing equipment varies in sophistication depending on the size of the vessel and techonology used. The trawlers in the study area have on-board facilities, communication equipment, modern sophisticated and safety equipment. All these assist the fishers in carrying out the fishing activities smoothly. In the study area, the total fixed capital investment incurred for acquisition of a trawl fishing vessel is the sum of the price of the hull, engine, the amount spent to modify vessel, reconditioning, cost of fishing gears (trawl and gillnets), fish holds, otter board, ropes, batteries and safety equipment. Amount to modify the vessel consists of money spent on equipment such as Very high-frequency (VHF) wireless communication devices, Vessel tracking system (VTS), Global positioning system (GPS), echo-sounder, mobile phones, fish finder, motorized winches and other accessories.

According to a study by Aswathy, Shanmugam, & Sathiadhas, (2011) in Kerala, the installation of advanced technological equipment like a fish finder, GPS, radio telephone has helped the fishers with mechanized vessels to venture for offshore regions and reach fishing ground to find shoals of fish. The dimension of the fishing gear depends on the size and the horsepower of the vessel. The price of the fishing gear (net) depends on the mesh size, length, and weight of the net. The respondents asserted that during the last ten years the cost price of trawlers has escalated. During the survey period, the respondents have opined that the price of a brand new trawler between size 32-38feet with wooden hull including the cost of fishing gear and other accessories would cost approximately ₹ 30 lakhs. A trawler of 38-45 feet costs approximately ₹ 40 lakhs, a 45feet to 60feet trawler would costs approximately ₹ 65 lakhs, and a trawler with steel hull above 60feet would cost approximately above ₹ 100 lakhs.

In table 6.10, the null hypothesis proposed is *"Across size of trawlers there is no significant difference between the average investments in fixed assets of trawlers"*.

The dependent variable is capital investment in fixed assets, and the independent variable is the size of the trawler. The same hypothesis is checked across jetties and the results are given in Appendix Table 6A, taking jetties as an independent variable. The table 6.10 presents the results of ANOVA test and it is evident that 37% to

Table 6.10 Results of ANOVA test of the Average Cost of Capital Investment in Fixed Assets against Size of the Trawlers

Variables(Capital investment in fixed assets)	Size of vessel categories			ANOVA	
	Small Trawler	Medium Trawler	Large Trawler		
	Mean(₹)	Mean(₹)	Mean(₹)	*F*-statistics	Sig.
Hull of trawler	340808_a **(37.00)**	661591_a **(43.38)**	1266209_b **(47.62)**	16.14	0.00**
Engine of trawler	110865_a **(12.04)**	202841_a **(13.30)**	394942_b **(14.85)**	15.28	0.00**
Amount to modify the vessel	53807_a **(5.85)**	94148_a **(6.17)**	160981_b **(6.05)**	11.18	0.00**
Reconditioning of vessel	370833_a **(40.26)**	480556_a **(31.51)**	663929_b **(24.96)**	10.85	0.00**
Cost of fishing gear(nets)	35769_a **(3.88)**	75364_b **(4.94)**	158128_c **(5.94)**	16.1	0.00**
Safety and other equipment	8906_a **(0.97)**	10648_a **(0.70)**	14831_a **(0.56)**	2.53	0.08
Total of mean of fixed asset	920988 **(100.00)**	1525148 **(100.00)**	2659020 **(100.00)**		
Total average investment in fixed asset	$\mathbf{1242265_a}$	$\mathbf{1830538_{a,b}}$	$\mathbf{2103272_b}$	**3.94**	**0.02****

Note: ****Variables significant at 5%, subscript a, b, c represents no significant difference and a,a,b and a, b,c means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of fixed asset, **Source: Researchers compilation from the data analysis based on primary survey.

47.62% of the total investment in fixed assets is spent on the hull itself. The ANOVA results conducted has revealed that a statistically significant relation is found between the variable hull of the trawlers against the size of the vessels (F=16.14, d. f. = (2, 75), p=< 0.05), and hence the null hypothesis is rejected. However, when the life of the trawler is considered, frequent repair and maintenance is a necessity for all sizes of vessels. The investment on reconditioning on trawlers is substantial and ranges from 26.96 % to 40.26%. It is higher for small size trawlers which are aged, compared to large sized trawlers. Moreover, there is a significant statistical relation in the investment on the reconditioning when the size of the trawler is cross-tabulated (F=10.85, d.f.=(2, 75), p=<0.05). The respondents have stated that reconditioning of the vessel is done approximately between 10-15 years to increase the life of the trawlers. The reasons for these differences of capital investment in fixed assets depends on the size of the trawler, horsepower of the engine, type of fishing gears and other equipment used. The results in table 6.10 reveals that the investment required in all other components is directly proportional to the investment required for the hull of the trawler.

The overall summary of results of capital investment in fixed assets across size of trawlers and across jetties given in table 6.11 reveals that the total average investment in the cost of fixed assets is statistically significant across the size of

Table 6.11 Summary of Statistical Significance of Average of Capital Investments in Fixed Assets by Trawler Owners

Capital Investment in fixed assets	Size of Trawlers	Jetties
Hull of trawler	Significant	Significant
Engine of trawler	Significant	Significant
Amount to modify vessel	Significant	Significant
Reconditioning of vessel	Significant	Not significant
Total cost of fishing gear	Significant	Significant
Safety and other equipments	Not significant	Not significant
Average of total fixed assets	Significant	Significant

Note: Results of ANOVA tests for Jetties available in Appendix (Table No 6A) **Source:** Researchers compilation from the data analysis based on Primary survey.

trawlers and jetties at 5% level of significance rejecting the null hypothesis. There is no subsidy given by the Government to construct/purchase hull, engine, amount to modify vessel, reconditioning, and cost of fishing gear. The respondents have incurred a substantial amount on capital investments towards hull and reconditioning of the trawlers. Majority of the respondents feel that subsidy should be provided by the government to purchase trawlers, nets, other accessories and also for reconditioning. It is hoped that the government will take a note of these problems and take positive steps to implement policies providing subsidies for fishers for the purchase of hull and reconditioning of vessels.

Discussion on investment in fixed assets will not be meaningful without considering the fixed costs. It is imperative to discuss fixed costs, as fixed costs are expenses incurred by the trawler owners to arrive at net profit. This will be discussed in section 6.3.5.4.

6.3.5.4 Fixed Costs incurred on Trawlers

The definition of fixed costs as well the rate of deprecation on the assets used for fishing purpose is given in Research methodology chapter section 3.2. In the table

6.12, ANOVA test is conducted to find the mean differences of fixed costs among different sizes of vessels. The null hypothesis stated is *"There is no significant relation between fixed costs across size of the trawlers".* The dependent variable is fixed costs and independent variable is size of the trawlers. The same hypothesis is checked across jetties, taking jetties as independent variable and the results are given in Appendix Table 6B. Results of ANOVA in table 6.12, shows that the percentage of depreciation on the hull, engine and reconditioning to the total mean is more for small

Table 6.12 Results of ANOVA test of Fixed Costs incurred by Trawler Owners

Fixed costs	Size of vessel categories			*f*-value	ANOVA
	Small Trawler	Medium Trawler	Large Trawler		
	Mean (₹)	Mean (₹)	Mean (₹)		
Depreciation on hull and engine	30667_a **(36.32)**	49201_a **(32.35)**	89812_b **(31.11)**	10.39	0.00**
Depreciation on cost to modify vessel	2615_a **(3.10)**	4596_a **(3.02)**	7915_b **(2.74)**	10.75	0.00**
Depreciation on Reconditioning	21269_a **(25.19)**	26357_a **(17.32)**	14993_a **(5.19)**	1.23	0.29
Depreciation on fishing gears (net)	5365_a **(6.36)**	11305_b **(7.43)**	21219_c **(7.35)**	16.1	0.00**
Depreciation on safety and other equipment	2478_a **(2.93)**	2378_a **(1.56)**	3323_a **(1.15)**	3.66	0.40
Insurance on vessel and crew	18416_a **(21.81)**	$34950_{a,b}$ **(22.97)**	70879_b **(24.52)**	6.83	0.00**
License fee and contribution for jetties maintenance	3616_a **(4.28)**	3323_a **(2.18)**	3679_a **(1.27)**	4.81	1.11
Finance costs Interest on loan	Nil	20000 **(13.14)**	76833 **(26.64)**	Nil	Nil
Total of fixed costs	**84426**	**152109**	**288653**		
	(100.00)	**(100.00)**	**(100.00)**		
Average of total fixed costs	$\mathbf{83880_a}$	$\mathbf{117807_a}$	$\mathbf{182409_b}$	11.11	0.00**

Note: ** Variable significant at 5% significance level, subscript "a, a, a" means no signficant difference and "a,b ,c" means there is significant difference. Figures in (parenthesis) indicate percentages to the total fixed costs. **Source:** Researchers compilation from the data analysis based on primary survey.

trawlers and medium-sized trawlers in comparison with large vessels. This can be attributed to the fact that the small and medium trawlers are comparatively old vessels (more than 30 years old) which require huge capital investment on reconditioning. Hence, depreciation on reconditioning is more for small and medium trawlers. Only a few large vessels have incurred cost of reconditioning as most of the large trawlers are younger in age, hence the percentage of depreciation on reconditioning costs, to the total of fixed costs is on the lower side. Larger the size of the trawler, more investments are required and hence substantial amount is spent by the respondents on interests on loan on the larger vessels. As such, the amount of depreciation on fishing gears is more for larger trawlers as more amount is invested in fishing gears compared to small and medium ones. Only a few respondents owning large size trawlers have taken insurance on crew and vessel as compared to small and medium size. The respondents owning small and medium size trawlers are of the opinion that high cost is involved on vessel insurance (premium). However, they will get the insurance claim only if their trawler is damaged. The insurance premium paid by the trawler owners on the crew is very low and varies from ₹ 101 to ₹103 per labour for entire fishing season (August to May). There is no statistically significant result evolved regarding interests on loan as the fishermen with small trawlers rely very less on loan from formal sources, but avail loan from informal sources for their financial exigencies. Most of the fishermen owning medium and large trawlers only have availed loans from formal sources.

Table 6.13 presents the summary of the statistical analysis of ANOVA tests conducted on the components of fixed costs against the size of the vessel and across jetties. The ANOVA tests results in Table 6.13, depicts that there is an overall

Table 6.13 Summary of Statistical Significance of Average Fixed costs Across Size of Trawlers and Jetties

Fixed costs	Size of Trawlers	Jetties
Depreciation on hull and engine	Significant	Not Significant
Depreciation on cost to modify vessel	Significant	Significant
Depreciation on Reconditioning	Not significant	Not significant
Depreciation on net	Significant	Significant
Depreciation on safety and other equipment	Not significant	Not significant
Insurance on vessel and crew	Significant	Significant
License fee and contribution for jetty Maintenance	Not Significant	Not Significant
Interests on loan	Not significant	Significant
Average of total fixed costs	Significant	Significant

Note: ANOVA, results for Jetty available in Appendix (Table No .6B), **Source:** Researchers compilation from the data analysis based on primary survey.

significant difference in the average of total fixed costs spent by the respondents when considered against the size of the trawlers and jetties. Depreciation on fixed assets and expenditure on insurance differs significantly across various sizes of the trawlers and jetties. The depreciation on safety equipment, license fee and contribution for maintenance of jetties is very negligible and hence the statistical association with the size of the trawler and the jetties was found to be insignificant. In case of depreciation on the hull and engine, when considered as a fixed cost, significant statistical association was evolving against the variable size of the trawler, whereas, there was no significant statistical relation as shown jetty wise. The reason for this is that there are more number of large trawlers found only in one or two jetties namely Malim and Cutbona.

The next discussion in section 6.4.5.5 is on the variable costs (operating cost). Operating costs is taken as a variable to arrive at the gross profit from trawl business.

6.3.5.5 Operating Costs Incurred on Trawlers

For the present study, the major components of the operating costs are "the operational costs calculated by adding together cost on fuel, wages, food, ration, batta to labour, repair and maintenance, costs of mending nets, costs of oil and lubricants, marketing and transportation cost and other miscellaneous expenses". A study by Sarma & K.S.Bose (2010) shows that there are seasonal variations in the fish catch as well as operational costs and earnings among trawlers. The null hypothesis stated is that, *"There is no significant statistical relationship between operating costs across size of trawlers".* ANOVA tests were conducted by taking operating costs as dependent variable and size of the vessel as the independent variable. The same hypothesis is checked across jetties and the results are given in Appendix Table 6C, taking jetties as an independent variable.

The results given in table 6.14 of one way ANOVA tests reveal that the highest percentage of total operating costs is incurred on fuel, followed by wages and cost of ice. The average consumption of fuel is very high across the size of fishing trawlers ranging from 40% to 50% of the total of operational costs. This is supported by the findings of a study by N. Aswathy, Narayanakumar, & Kuriakose, (2014) which found that 76% of the costs were incurred on fuel by the trawlers in India. A study conducted in Kerala on the economic efficiency of deep sea shrimp fishery operations, finds that fuel constituted 55% of the total operating cost (Shanis, Salim, Shridhar, & Pillai, 2014). The results show that cost of fuel is highest for the large trawlers as they venture into deep sea fishing ranging between approximate 10-15 days per trip and also stay for longer hours during prawn fishing season from August to October. This is supported by the findings of a study by Geetha et al., (2014) which showed that multi-day trawlers travel a longer distance, consume more fuel and use mechanical power for propulsion and fishing. In another study, it was found that one-third of the earnings received is spent by fishermen on fuel (Rajasenan, 1987). All these studies suggest that fuel is the most important and significant cost involved in the fishing operations and the same is true for trawlers in Goa.

Table 6.14 Results of Independent Sample *t* test of Operating cost incurred by Trawler Owners

Variables	Size of vessel categories			ANOVA	
	Small Trawler	**Medium Trawler**	**Large Trawler**		
	Mean (₹)	**Mean (₹)**	**Mean (₹)**	***F*-value**	**Sig.**
Fuel cost after diesel VAT subsidy	640352_a	1003160_a	1718916_b	29.22	0.00^{**}
	(43.98)	**(47.40)**	**(49.50)**		
Wages to labour	420463_a	604998_a	947781_b	27.82	0.00^{**}
	(28.88)	**(28.59)**	**(27.29)**		
Food , batta and (Ration)	61231_a	92925_a	145777_b	29.84	0.00^{**}
	(4.21)	**(4.39)**	**(4.20)**		
Cost of Ice	96883_a	123280_a	263133_b	32.87	0.00^{**}
	(6.65)	**(5.83)**	**(7.58)**		
Regular maintenance	75385_a	102593_a	157575_b	25.59	0.00^{**}
	(5.18)	**(4.85)**	**(4.54)**		
Mending of nets	57321_a	85386_b	109322_c	14.5	0.00^{**}
	(3.94)	**(4.03)**	**(3.15)**		
Oil and Lubricants	35588_a	37277_a	47434_b	5.77	0.00^{**}
	(2.44)	**(1.76)**	**(1.37)**		
Marketing and Transportation	63820_a	60960_a	75760_a	0.68	0.50
	(4.38)	**(2.88)**	**(2.18)**		
Miscellaneous Expenses	4817_a	5719_a	7377_a	3.24	0.04^{**}
	(0.33)	**(0.27)**	**(0.21)**		
Total operating costs	**1455860**	**2116298**	**3473075**		
	(100.00)	**(100.00)**	**(100.00)**		
Average of total operating costs	$\mathbf{1844479_a}$	$\mathbf{2405833_{a,b}}$	$\mathbf{2959834_b}$	**5.95**	$\mathbf{0.00^{**}}$

Note: ** Variable significant at 5% significance level, a,a,a means no significant difference and a,b,c means there is significant difference. Figures in (parenthesis) indicate percentages to the total operating costs, **Source:** Researchers compilation from the data analysis based on primary survey.

The next important factor of production is labour. The total payment of wages made to the crew consisted of wages, incentives (crew share), cost of food and "*Batta*". The commission given by the trawler owners to the crew is locally known as "*Batta*". Some respondents gave a fixed salary for the labourers, besides "*Batta*" and food whereas; some respondents operate on percentage share of wages. The captain of the trawler locally known as "*Tandel*" receives higher wage as compared to the other employees. The larger vessels employ two captains and the smaller vessels employ one captain. In the method of percentage share of wages, the respondents deduct the diesel fuel expenses from the gross revenue earned from the catch per trip. Thereafter, on remaining net revenue the "*Tandel*"(captain) of the trawl vessel is paid on a percentage basis. The first tandel is given (5%) and second tandel (4%) of the net revenue. The wages of the first tandel can range on an average approximately between ₹ 25,000 to ₹ 100,000 p.m. depending on the season, catch and net revenue. The other crew will get fixed amount of average wage ranging between ₹ 8,000 to ₹ 10,000 per month, besides "*Batta*". The wages depends on the experience of the labourer. Sea going incentives are given to first "*Tandel*" approximately between ₹ 900 to 1000, and second "*Tandel*" gets an approximate of ₹ 400 to ₹ 500 and the rest of the labourers get ₹ 100 to ₹ 200 per trip. Food and miscellaneous expenses of the crew are borne by the trawler owners. The fish is stored in the ice boxes covered with ice in the fish holds. Sufficient quantity of ice is taken for every trip to preserve the freshness of fish caught. The percentage of ice also is higher for larger vessels as they go for deep sea fishing. The larger vessels have bigger fish holds to carry more ice on board. Repair, general maintenance and lubrication expenses are incurred to maintain the efficiency of the vessel. The respondents narrated that the post-monsoon season (August–November) is the favourable season for fishing as best quality prawns and fish species are caught during this season, resulting in more fish catch and income.

In table 6.15, a summary of average of operating costs, using the ANOVA test depicts that the total average of operating costs is significant across the size of vessels

Table 6.15 Summary of Statistical Significance of Operating Costs across the Size of Trawlers and Jetties

Variables	Size of Trawlers	Jetties
Fuel cost	Significant	Significant
Wages	Significant	Significant
Food, Batta, and Ration	Significant	Significant
Cost of Ice	Significant	Significant
Repair and Maintenance	Significant	Significant
Mending Nets	Significant	Not Significant
Oil and Lubricants	Significant	Not Significant
Marketing	Not Significant	Not Significant
Miscellaneous expenses	Significant	Significant
Total average of operating cost	**Significant**	**Significant**

Note: ANOVA Results for Jetties available in Appendix (Table No. 6C). **Source:** Researchers compilation from the data analysis based on primary survey.

and jetties. Among all operating costs, the costs of fuel, wages, food to labour, cost of ice, repair and maintenance, miscellaneous expenses differ as per the size of the trawlers and jetties. These differences are due to the size of the vessels, the jetties from which they operate as well as the infrastructure facilities available at different jetties. The differences are also due to the fuel consumption, number of labourers employed, number of trips undertaken, age of the vessel, breakdown of vessel and several other factors. The cost of fuel, wages paid to the labourers, cost of ice influence earnings, gross profit and net profit in the study area. The concentration of large sized vessels on Malim and Cutbona jetties is the reason for the statistical relation towards jetties under the study. Hence, it is suggested that by introducing fuel efficient vessels and low cost fuels (e.g. Biodiesel) in place of fossil fuels, the net profit of the fishermen can be enhanced to a considerable extent. Sincere efforts are already being undertaken by CMFRI and Central Institute of Fisheries and Technology (CIFT) towards attaining this goal. The section 6.3.5.6 discusses the other operational factors, namely; fishing trips, fishing days, fishing hours, influencing the earnings, gross and net profit of the trawling business.

6.3.5.6 Other Factors Affecting Operations of Trawling Business

The null hypothesis proposed is that "*Across the size of trawlers there is no significant statistical relation between fishing trips, fishing days, fishing hours for entire fishing season from August to May*". The dependent variable is fishing trips, days and hours and the independent variable is the size of the trawlers. The same hypothesis is checked across jetties and the results are given in Appendix Table 6D, taking jetties as an independent variable. The one way ANOVA test results in table 6.16 indicates the statistical relation between these variables. In table 6.16, fishing

Table 6.16 Results of ANOVA test of Fishing Trips, Days and Hours of Trawlers for Entire Season (August to May)

Variables	Size of vessel categories			ANOVA	
	Small Vessel	Medium Vessel	Large Vessel		
	Mean	Mean	Mean	F-value	Sig
Total trips	161_a	102_b	45_c	40.31	0.00**
Fishing days	205_a	201_a	216_a	2.414	0.09
Fishing hours	848_a	892_a	1133_b	12.09	0.00**

Note: ** Variable significant at 5% significance level, subscript "a,a,a" means no signficant difference and "a,b,c "means there is significant difference, **Source:** Researchers compilation from the data analysis based on primary survey.

trips and fishing hours significantly differ between small, medium and large trawlers due to the following reasons. The small size trawlers go only for single day trawling, as the trawler does not have the capacity for multi-day fishing due to its size. The small size trawl vessels make approximately 2-3 trawls per day, each trawl approximately of two to three fishing hours. The medium size trawlers do approximately 3-4 trawls per day, each approximately of 4-5 hours and go for multi day fishing ranging between 5-10 days. The large size trawlers go for deep sea fishing for 5-15 days and do 4 trawls per day, each trawl of approximately of 4 hours for each trawl. The main reason of trips being more in case of small trawlers as compared to medium and large trawlers is that small trawlers make on an average one or two trips per day of shorter duration. The respondents expressed that the trips are totally dependent on weather and climatic conditions. The trawler owners claimed that many fishing days and trips are lost due to bad weather conditions such as rough sea, cyclonic winds and other factors. All types of trawlers make maximum trips during the most favourable post-monsoon peak season (August-November) as the fish catch is easily available in the closest vicinity. During the months, December to May, fishers will have to go deep seas resulting in less number of trips and more number of fishing days. The respondents stated that multi-day and deep sea fishing operations are economical for them as they can save the costs of expenditure on fuel. The use of technical equipment helps the trawlers to venture into the sea for single day, multi-day and deep sea fishing.

The table 6.17 provides the summary of average fishing trips, fishing days and fishing hours across the size of trawlers and the jetties. The size of the vessel as a variable has statistically significant relation to the number of fishing trips and hours.

Table 6.17 Statistical Significance of Fishing Trips, Days and Hours Across the Size of the Trawlers and the Jetties (August to May)

Variables	Size of vessel	Jetties
Total fishing trips	Significant	Significant
Total fishing days	Not Significant	Significant
Total fishing hours	Significant	Significant

Note: ANOVA results for jetties available in Appendix (Table No.6D) **Source:** Researchers compilation from the data analysis based on primary survey.

The jetties have a significant relation with the number of trips, days and hours. The reason is that small sized trawlers are more congregated in some jetties viz. Chapora and Vasco. Even though the fishing days are not having significant statistical relation with the size of the trawlers, fishers of Chapora jetty complained that they could go for fishing only after two months of the starting of the fishing season as their trawlers faced problems due to the sand bar obstruction in Chapora river. Due to this, trawler owners at Chapora jetty lose fishing days resulting in the loss of revenue. However, recently the government has proposed for dredging of sand at the Chapora jetty.

The next section 6.4.5.7 shows the analysis of key economic indicators of trawlers as it is important to understand the viability of trawling business.

6.3.5.7 Analysis of Costs, Earnings and Profits of Trawling Business

The economic performance of trawlers and the trawl fishing methods is assessed with the help of the economic indicators which depends on the costs fishermen incur, earnings and profits made by them from fishing business. Hence, an investigation of costs, earnings and profits would give a clear picture of the trawling business in Goa. Statistical test, one way ANOVA is conducted to find the statistical relationship between the variables, size of the trawler and jetties towards costs, earnings and profit per trip. The computation of gross revenue, gross profit and net profit is given in Research Methodology chapter in section 3.2 in equation 3.1, 3.2 and 3.3. The null hypothesis proposed is that, *"Across the size of the trawlers there is no significant difference between costs, catch, earnings and profits per trip of trawlers".* The same hypothesis is checked across jetties and the results are given in Appendix Table 6E, taking jetties as an independent variable. The one way ANOVA tests results of economic indicators of trawlers given in table 6.18, reveals that costs and profits are significant across size of vessels, rejecting the null hypothesis. The

Table 6.18 Analysis of Costs, Earnings and Profits Across the Size of the Trawlers for the Entire Season (August to May)

Variables	Size of vessel categories			ANOVA	
	Small Vessel	Medium Vessel	Large Vessel		
	Mean	Mean	Mean	***F*-value**	**Sig**
Operating cost per trip (₹)	14492_a	31043_a	71988_b	30.36	0.00**
Total fixed cost per trip (₹)	646_a	1686_a	4669_b	21.53	0.00**
Total costs per trip (₹)	15138_a	32729_a	76657_b	31.10	0.00**
Total catch **(in kgs)**	17532_a	22394_a	38518_b	15.96	0.00**
Catch per trip **(in kgs)**	122_a	317_a	956_b	31.4	0.00**
Earnings/ Gross Revenue per trip (₹)	13290_a	36361_a	107279_b	54.67	0.00**
Gross profit per trip (₹)	4312_a	9279_a	22807_b	22.02	0.00**
Net profit per trip (₹)	3666_a	7593_a	18138_b	16.93	0.00**

Note: ** Variable significant at 5% significance level, subscript" a,a,a" means no signficant difference and "a,b" means there is significant difference, Total costs per trip represents sum of operating and fixed costs per trip
Source: Researchers compilation from the data analysis based on primary survey.

medium and large trawlers which undertake multi-day and deep sea fishing, get more catch, earned more gross revenue, gross and net profit and performed better than the small trawlers. The net profit of large vessels is almost five times more than that of the small vessels. Due to these factors, large vessels are sustainable in the long run as compared to the small and medium trawlers. Medium trawlers performance is average but small trawlers earn low gross profit and net profit and find it difficult to sustain as major portion of their earnings is spent on fuel and other operational expenses. The respondents claimed that the high priced and exportable quality of species of fish such as prawns and other fish fetches them high income. The gross revenue (earnings) depends on the catch composition, quality of species of fish catch and the price prevailing in the market, which further depends on the demand and supply of fish. The price is decided by the trader's i.e wholesale agents depending on the demand and supply of fish.

Table 6.19 provides the summary of statistical relation existing between the variables related to costs and profit towards the two variables, the size of the trawler

Table 6.19 Summary of Statistical Significance of Costs, Earnings and Profit Across the Size of the Trawlers and Jetties for the Entire Season (August to May)

Variables	Size of vessel	Jetties
Total Operating cost per trip (₹)	Significant	Significant
Total fixed cost per trip (₹)	Significant	Significant
Total cost per trip (₹)	Significant	Significant
Total catch **(in kgs)**	Significant	Significant
Catch per trip **(in kgs)**	Significant	Significant
Earnings/Revenue per trip (₹)	Significant	Significant
Gross profit per trip (₹)	Significant	Significant
Net profit per trip (₹)	Significant	Significant

Note: ANOVA Results for Jetties available in Appendix (Table No 6E), **Source:** Researchers compilation from the data analysis based on primary survey.

and the jetties. The results in table 6.19 shows that the total costs, catch, earnings and profit per trip are signficant across the size of the trawlers and the jetties. The total costs, gross profit and net profit per trip were highest at Malim jetty as shown in Appendix (Table 6E). As per respondent's claim, gross earnings are more in post monsoon season (August to November). The trawlers make fewer days of trips, and thus save on fuel cost during post-monsoon season when shoals of fish are available in the near vicinity. From the statistical results obtained it can be inferred that there exists a statistically significant relation across the size of trawlers and jetties.

In the next section 6.3.6, an attempt is made to study the impact of socio-economic characteristics, and geographic location (by districts) of fishermen owning trawlers in Goa on the net profit, earnings and savings from trawl fishing business.

6.3.6 Regression Analysis

This section analyses the impact of socio-economic characteristics, and geographic location (by districts) of the respondents on the net profit, earnings from fish catch and the savings from trawling business in Goa for the entire fishing season August to May. A multiple linear regression model is chosen to study the impact of above mentioned three factors, on the three dependent variables, using three different equations. The dependent and independent variables are defined in the Research Methodology chapter section 3.6. The dependent variables are net profit, earnings from the fish catch and savings from fishing business. The independent variables are socio-economic characteristics of the respondents and districts. The calculation of net profit and savings is given in Research Methodology chapter section 3.2 and equation 3.3. The section 6.3.6.1 discusses the impact of socio-economic characteristics, on the net profit, earnings and savings from fishing business.

6.3.6.1 Impact of Socio-economic Characteristics on the Net profit, Earnings and Savings

The independent variables chosen for the regression model are as follows: $X_{1=}$ Gender of the respondents (Dummy variable, male=1 and female= 0), X_2 = Caste of the respondents, three dummy variables were created for SC, ST and OBC, OBC as 1 and General category as 0, there were no SC and ST respondents involved in trawl fishing, $\boldsymbol{X_3}$=Educational qualification of the respondents (in years), X_4= Size of family (number), $\boldsymbol{X_{5=}}$ Experience in fishing business (in years), X_6=Number of family members involved in fishing (number), $X_{7=}$ Financial status by poverty line of the respondents (Dummy variable Above Poverty Line=1, and Below Poverty Line=0), Y_1 is the dependent variable and denotes net profit, Y_2 is the earnings from fish catch in value and Y_3 is savings from fishing business, u_i is the residual error term assumed to have a zero mean and constant variance.

It is hypothesized that *"Socio-economic characteristics have an impact on the net profits, earnings from fish catch and savings from trawling business."* While testing the multiple linear regression models, the null hypothesis, stated is that, *"Socio-economic characteristics have no impact on the net profits, earnings from catch and savings from trawling business."* Three multiple regression equations specified are mentioned in Research Methodology chapter in section 3.8.7.3. equation number 3.17, 3.18 and 3.19. There were 78 responses which were considered for this multiple regression model. The tests revealed that age and number of years of experience in fishing business had issues of multi-collinearity. Hence, age as a variable has been dropped from the variables for this model. Instead, the number of years of experience of fishermen in fishing is used as proxy for age.

6.3.6.1.a Impact of Socio-economic Characteristics on the Net profit

In case of the multiple regression model given in table 6.20, assumptions of linearity and homoscedasticity were verified by scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multi-collinearity was also observed using VIF values which were less than 5 concluding that the assumptions of multi-collinearity is met. The multiple regression model given in table 6.20 as equation 1(6.1) explains the following results. The model predicts the dependent variable and the coefficient of determination, Adjusted R^2 indicates 26.3% variation in net profit is only explained by the socio economic variables, whereas, 73.7% variation is determined by other factors not considered. Gender, caste, poverty line, educational qualification, size of family members, experience in fishing business and the number of family members involved could statistically predict the net profit, $F(7,70) = 4.44$, $p = 0.03 < 0.05$. The negative slope coefficients were observed for the variables size of the family and number of family members involved in fishing. It is observed that there is a positive slope coefficient for caste, financial status by poverty line, educational qualification, and experience in fishing business. The variables that are statistically significant at 5% significance level, are gender (p=0.01), and educational qualification (p= 0.02).

A positive relationship is observed between variables, gender and net profits, and it is in line with the hypothesis. The variable gender i.e male respondents are showing significant difference, as out of 78 respondents, six are female respondents, male respondents have more experience in handling the trawl fishing business as compared to female respondents, and earn higher profits as compared to the females. If a male respondent is involved in fishing business compared to a female respondent, net profit of a male respondent on an average would increase by ₹ 422692, keeping other variables constant, statistically significant at 5% level. Hence, the null hypothesis is rejected. As expected a positive relation exists between educational

Table 6.20 Impact of Socio-Economic Characteristics of Fishermen on Net profit, Earnings and Savings from Trawlers

Socio-economic variables	Equation 1 (6.1) Net Profits (Y_1)			Equation 2(6.2) Earnings from Catch (Y_2)			Equation 3 (6.3) Savings from fishing business (Y_3)		
	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value
(Constant)	720075	2.28	0.02	2339746	1.96	0.05	106930	0.93	0.35
X_1 I_s *Male*	422692	2.45	0.01**	515929	0.79	0.43	-11642	-0.19	0.84
X_2 I_s *Caste (OBC) with respect to SC,ST and General*	17275	0.11	0.91	-64636	-0.11	0.91	-16972	-0.32	0.75
X_3*Qualification (Yrs)*	32303	2.27	0.02**	66653	1.24	0.21	12938	2.60	0.01**
X_4 *Size of family members (No.)*	-29871	-1.06	0.29	-114470	-1.07	0.28	-10998	-0.97	0.33
X_5 *Experience in fishing business (Yrs)*	6099	1.2	0.23	6277	0.32	0.74	1262	0.72	0.47
X_6 *Family members involved in fishing business (No.)*	-39245	0.58	0.55	115278	0.45	0.64	-12256	-0.50	0.61
X_7I_s*(APL)*	69153	0.54	0.59	1458517	3.02	0.00**	90343	2.02	0.04**
Adjusted R^2	26.3%			32%			31%		
F and *p* value	*F*-value =4.44	*p* =0.031		*F*-value = 5.35	*p*= 0.03		*F*-value = 5.31	*p*= 0.03	

Note: variable significant at **5%, **Source**: Researchers compilation from the data analysis based on primary survey.

qualification and net profit statistically significant at 5% level, rejecting the null hypothesis. An increase in educational qualification of the respondent by one year would increase the net profit on an average by ₹ 32303, keeping other variables as constant. This is expected as the level of education increases of the respondents it also has an influence on choices made with the fishing techniques resulting in an increased fishing output and higher profits. As expected, a positive relation is observed for poverty line and experience in fishing business and net profit although not significant at 5% level, thus failing to reject the null hypothesis.

A negative statistical relation was expected for variables, caste and net profit and it is not in line with the results obtained, also not statistically significant at 5% level. A positive relation was expected between family members involved in the fishing business and net profit. However, the results exhibited a negative relation, which is not statistically significant at 5% significance level. A negative relationship was found between the variables size of the family and net profit which was not statistically significant at 5% level of significance, failing to reject the null hypothesis. Thus, the two explanatory variables which have an impact on net profit are gender i.e male respondents and educational qualification.

6.3.6.1.b Impact of Socio-economic Characteristics on the Earnings from Fish catch

In table 6.20, equation 2(6.2), analyses the impact of socio-economic characteristics on the earnings from fish catch. The Adjusted R^2 for the overall model in table 6.20, for equation 2(6.2) was 32%**.** Gender, caste, poverty line, qualification, size of family members, experience in fishing business and number of family members involved could statistically predict the earnings from fish catch, $F(7,70)=5.35$, $p<0.05$. The negative slope coefficients were observed for variables caste and size of family. It is observed that there is a positive slope coefficient for gender, poverty line, educational qualification, experience in fishing business and family members involved in fishing. The variables that are statistically significant at 5% significance level is financial status by poverty line ($p=0.00$). As expected there is a positive relation between financial status by poverty line and earnings and it is in line with the results obtained statistically significant at 5% level, rejecting the null hypotheses. The results show that the respondents belonging to APL when compared to BPL category would have more earnings from fish catch on an average by ₹ 14,58,517 keeping other variables as constant. This also implies that socio-economic status of above poverty line respondents has improved compared to respondents belonging to below poverty line.

The results of equation 2(6.2) in the model shows that there is a positive relationship between gender, qualification, experience, family members involved in fishing and earnings from fish catch and is in line with the hypothesis, however, not statistically significant, failing to reject the null hypothesis. Thus, these factors have no impact on earnings of the respondents. As per the hypothesis, a negative relation is expected for the variables, caste, size of the family and earnings and it is in line with the results, however, not statistically significant at 5% level, failing to reject the null hypothesis. The overall results of equation 2 (6.5) regression model reveals that out of all the socio-economic independent variables, only financial status, poverty line index has statistically significant impact on the earnings of fishermen.

6.3.6.1.c Impact of Socio-economic Characteristics on the savings

The multiple regression model given in table 6.20 in equation 3(6.3) explains the impact of socio-economic characteristics on the savings from fishing business. The model predicts the dependent variable and returns an Adjusted R^2 for the overall model as 31%. Gender, caste, poverty line, qualification, size of family members, experience in fishing business and number of family members involved in fishing could statistically predict the savings, $F(7,70)=5.31$, $p=0.03<0.05$. There is a positive slope coefficient for variables, poverty line and educational qualification and is in line with the hypothesis. The variables that are statistically significant at 5% level of significance is APL (p=0.04) and educational qualification (p=0.01). Thus, the null hypothesis is rejected. If a respondent belongs to APL category, compared to BPL, than the savings of APL will increase on an average by ₹ 90,343 per annum, compared to BPL respondent, keeping all other variables as constant. Similarly, in case of variable educational qualification, every additional year of an increase in educational qualification of the respondent, savings on an average would increase by ₹ 12938, keeping other variables as constant. There is a positive slope coefficient for variable experience in fishing business which in line with the hypothesis, not statistically significant at 5% level, failing to reject the null hypothesis. A negative slope coefficient is observed for variables namely; gender, caste, size of the family and family members involved in fishing business. The two explanatory variables, caste and size of the family are found not to be statistically significant, although they have the expected signs, failing to reject the null hypothesis. But for the variables, gender and family members involved in fishing business, results were contrary to the expectations, not statistically significant, failing to reject the null hypothesis. The variables, financial status by poverty line index and educational qualification have significant impact on the savings of the fishermen.

Thus, the overall results of multiple regression model shows that among all the socio-economic independent variables, considered in the model the variables, gender and educational qualification of the respondents have impact on the net profit. The variable financial status poverty line index (APL) has impact on the earnings of fishermen. The variables educational qualification and financial status by poverty line index have impact on savings of fishermen. An APL respondent would have higher income compared to BPL category and would be able to save more than BPL respondent. Higher education levels are associated with higher income resulting in higher savings.

In the next section 6.3.6.2, the impact of geographic location (by district) on the net profit, earnings and savings is discussed by using simple linear regression model.

6.3.6.2 Impact of Geographic Location (by district) on the Net profit, Earnings and Savings

Alfred Weber's (1909) theory which emphasises the geographical location of an economic activity is used for this simple linear regression model. The linear regression model was used to study the impact of geographic location (by district) on the net profit, earnings from fish catch and savings of fishermen. The null hypothesis proposed is that, *"There is no impact of geographic location (by districts) on the net profit, fish catch and savings of trawler owners with respect to location".*

In the linear regression model, Y_4 is the dependent variable and it denotes the net profit, Y_5 is dependent variable which denotes earnings from fish catch and Y_6 is the dependent variable that denotes savings from fishing business. The independent variable is X_1 i.e. District, (Dummy variable North Goa =1 and South Goa =0). u_i is the residual error term assumed to have a zero mean and constant variance. There were 78 responses for this linear regression model. The three linear regression equations and the expectations are mentioned in Research Methodology section 3.8.7.4 and equation 3.13, 3.14 and 3.15 respectively.

The table 6.21 presents the results of the linear regression model, showing the impact of districts on net profits, earnings and savings. The assumptions of linearity and homoscedasticity were verified by scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multi-collinearity was also observed using VIF values which were less than 5 concluding that the assumptions of multi-collinearity is met.

Table 6.21 Impact of Location viz. District on Net Profit, Earnings and Savings of Fishermen Owning Trawlers

District	Equation 4 (6.4)			Equation 5(6.5)			Equation 6 (6.6)		
	Net Profits (Y_7)			Earnings from Catch (Y_8)			Savings from fishing business (Y_9)		
	Unstandardized Coefficient	t-value	p-value	Unstandardized Coefficient	t-value	p-value	Unstandardized Coefficient	t-value	p-value
Constant	576296	10.80	0.00	3108310	12.92	0.00	231053	8.09	0.00
X_1North Goa	168288	1.96	0.05*	623418	1.85	0.06*	55572	1.39	0.16
R^2	4%			4%			2%		
	***F*-value** =3.82	*p*=0.05		***F*-value** =3.44	*p*= 0.06		***F*-value**=1.94	*p*=0.16	

Note: Variable significant at *10% significance level, Constant is South Goa as reference category,
Source: Researchers compilation from the data analysis based on primary survey.

6.3.6.3.a Impact of District on Net profit

The model given in table 6.21 in equation 4(6.4) predicts the dependent variable and the R^2 indicates 4% variation in net profit is only explained by the districts, whereas 96% variation is determined by other factors. The variable district, North Goa could statistically predict net profit, $F(1,76)=3.82, p=0.05<0.10$. The positive slope is observed for districts and is in line with the hypothesis, however, variable district North Goa is statistically significant at 10% significance level. Thus, the null hypothesis is rejected. It is evident from the results that the respondents from North Goa, involved in trawl fishing business would earn more net profit on an average by ₹ 1,68,288 compared to respondents having trawl business in South Goa.

6.3.6.3.b Impact of District on Earnings

The model in table 6.21, equation 5(6.5) predicts the dependent variable and the R^2 indicates 4% variation in earnings is only explained by the districts, North Goa whereas, 96% variation is determined by other factors. The district North Goa could statistically predict earnings, $F(1,76)=3.44$, $p=0.06<0.10$. The positive slope was observed for districts and is in line with the results expected, however, the variable district, North Goa was statistically significant at 10% significance level, rejecting the null hypothesis. Thus, the variable district North Goa has impact on the earnings of the respondents. It is evident from the results that the earnings of a respondent having business in North Goa would be more by ₹ 6,23,418 on an average compared to a respondent from South Goa.

6.3.6.3.c Impact of District on Savings

The model in table 6.21, in equation 6(6.6) predicts the dependent variable and the R^2 indicates 2% variation in savings is only explained by the explanatory variable district, whereas, 98% variation is determined by other factors. The variable district North Goa could not statistically predict savings, F (1,76) =1.94, p=0.16>0.10. The positive slope was observed for districts and is in line with the results expected. However, variable district, North Goa is not statistically significant at 10% significance level, which shows that district has no impact on the savings of the respondents, hence failing to reject the null hypothesis. The savings of a respondent belonging to North Goa would be more by ₹ 55,572 on an average as compared to a respondent from South Goa. The overall results in linear regression model shows that the variable district North Goa has an impact on the dependent variables, net profit and earnings from fish catch but has no impact on the savings of the fishermen.

The next discussion given in 6.3.7 explains the factors of production which are important in determining the output from fish catch in terms of earnings.

6.3.7 Factors of Production Influencing the Earnings of Trawler Owners Based on Cobb Douglas Production Model

Cobb Douglas Production theory is the best model fit to analyze fish catch earnings (Ramakrishnan, 1994). Najmudeen & Sathiadhas (2007) used the production function of Cobb-Douglas model to find the association between input and output of 50 trawlers in Kerala. This model is used because it examines the relationship between the level of input and the resultant level of output. A Cobb Douglas production function using multiple linear regression model is used in the present study to examine the relationship between the input of factors of production and the output of fish catch viz. the gross earnings. The selected independent variables and the dependent variable used for the multiple regression model using Cobb Douglas theory are defined in the Research Methodology chapter section 3.6 and the equations are given in section 3.8.7.5. equation 3.21. Based on the Cobb Douglas theory, it is hypothesized that "*There is an impact of selected input of factors of production on the earnings from output of fish catch of trawlers".* The null hypothesis proposed is that "*The selected input of factors of production has no impact on the earnings from the output of fish catch of trawlers.*"

The multiple regression model is estimated on the basis of 78 responses. As per table 6.22, the log-log model form of regression is used. The dependent and independent variables were transformed into log to satisfy the Shapiro test of normality value of more than 0.05. To maintain uniformity log was taken for all

Table 6.22 Impact of Selected Input of Factors of Production on the Earnings of Fish Catch from Trawlers using Cobb Douglas Theory

Variables	**Equation 7(6.7) Log of Earnings from catch**			
	Unstandardized Coefficient (Beta)	**Beta x100**	***t*-value**	***p*-value**
(Constant)	3.81	381	4.94	0.00
X_1 Ln experience of fishing business	0.02	2.00	0.88	0.38
X_2 Ln horse power	0.15	15.40	2.19	0.03**
X_3 Ln total cost of fishing gear	-0.03	3.00	-0.87	0.38
X_4 Ln total wages	0.52	52.00	7.06	0.000**
X_5 Ln fishing hours	0.53	53.20	5.44	0.000**
X_6 Ln fishing trips	-0.10	10.00	2.61	0.01**
X_7 Ln fuel cost after VAT subsidy	0.03	3.00	0.70	0.48
Adjusted R^2	0.84		*F*-value =94.01, *p*= 0.000	

Note: Variable significant at **5%, Ln=log, **Source**: Researchers compilation from the data analysis based on primary survey.

dependent and independent variables. The production function was specified as log of earnings from output of fish catch as the dependent variable and the log of experience in fishing, log of horsepower of trawler, log of total cost of fishing gear, log of total wages paid to labour, log of fishing hours, log of fishing trips, log of fuel cost after reimbursement of diesel VAT subsidy as seven independent variables. Assumptions of linearity and homoscedasticity were verified by the scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multi-collinearity is also observed using VIF values which were less than 5 concluding that the assumptions of multi-collinearity is met.

The multiple regression model given in the table 6.22 and the equation 7 (6.7) is fitted and it is found to be a statistically significant model, $F(7,70) = 94.01$, $p=<0.05$, at 5% significance level. The coefficient of multiple determination, Adjusted R^2 for the overall model was 0.84, suggests that all the seven independent explanatory variables included in the function jointly explain 84% variation in the dependent variable, only 16% variation is due to other factors which have not been considered. The negative slope coefficients were observed for variables, log of cost of fishing gear and fishing trips. It is observed that there is a positive slope coefficients for variables log of experience in fishing, log of horsepower of trawler, log of wages paid to labour, log of fishing hours, and log of fuel cost after reimbursement of diesel VAT subsidy. Out of the seven independent variables, log of horsepower, ($p= 0.03$), log of wages paid to labour ($p=0.000$) and log of fishing hours ($p=0.000$) were statistically significant at 5% significance level. These variables have statistically significant influence on earnings. In equation 7(6.7) in the model it is observed that there is a positive relationship between all the seven independent variables and dependent variables, however, only in case of log of fishing gear and log of fishing trips it is a contrary to the expectation. There is a negative relation observed between log of fishing gear and log of earnings, not statistically significant. The result implies that for 1% increase in the cost of fishing gear, there is 3.0% decrease in earnings on an average, but not statistically significant, ($p=0.38>0.05$), failing to reject the null hypothesis. In case of log of fishing trips and log of earnings, negative relation is observed but statistically significant. This also implies that for 1% increase in the fishing trips, there is 10% decrease in the log of earnings, on an average, statistically significant, ($p<0.05$), hence the null hypothesis is rejected.

In the case log of experience, log of fuel cost after VAT subsidy and log of earnings there is positive relation as expected but their impact on log of earnings is not statistically significant at 5% level, failing to reject the null hypothesis. As expected, a positive relation is observed between the variable horsepower and earnings, statistically significant at 5% level, ($p<0.05$). This implies that for one percent increase in horse power, there will be 15.4% increase in log of earnings on an average, keeping other variables as constant. In this case the null hypothesis is rejected. This implies that if the respondents use higher engine capacity horsepower, for trawling vessel, it will help the trawlers to travel faster, resulting in getting more catch thus having a significant impact on earnings. A positive relation is expected between log of wages and log of earnings, and it is in line with the results, statistically significant at 5% level, ($p < 0.05$). In this case, the null hypothesis is rejected. This implies that one percent increase in the wages of labour will result in 52% increase on an average in the log of earnings. This study submits that investment and employment of the right skilled and experienced labour in fishing will help the trawler owners to increase their earnings from fishing business.

As expected there is a positive relation between log of fishing hours and log of earnings, and it is in line with the results statistically significant at 5% level, ($p < 0.05$). This means that one percent increase in the number of productive fishing hours will result in 53.2% increase on an average in earnings, keeping all variables as constant, rejecting the null hypothesis. Thus, the variable productive fishing hours will help the respondents to get more fish catch resulting in more earnings. A positive relation is expected between log of fuel cost after subsidy and log of earnings, and it is in line with the results obtained but not statistically significant at 5% level, ($p=0.48>0.05$). The overall results of the log-log regression model shows that three variables namely; horse power of trawlers, wages paid to labourers, fishing hours has a statistical significant positive functional relationship on the earnings. The results of the log log multiple regression model using Cobb Douglas theory brings to light that there is ample scope for the trawler owners to enhance their earnings by investing in vessels with more horsepower engines, employing additional labour and increasing fishing hours will help them to earn reasonable earnings. Though the other independent variables considered in this model, viz. experience in fishing, fishing gear, fuel cost after VAT subsidy has positive relation on the output of fish catch, their impact on earnings from production is not significant.

The analysis of the economic indicators of the fishing crafts is given in section 6.3.8, which are important to determine the economic efficiency of the trawl vessels. The economic indicators are important to understand the economic and financial performance of the trawlers. Shanis et al. (2014) studied the economic efficiency indicators with the help of ratios to determine the input output efficiency of trawlers.

6.3.8 Ratio Analysis of Economic Indicators of Trawlers

This study estimates the key economic indicators of the trawl fishing business on the basis of capital investments, costs and earnings data. The formulae's used for different economic indicators are defined in Research Methodology chapter, section 3.8.7.6, equation number 3.22 to 3.40. Table 6.23, gives the analysis of the economic indicators used to measure the economic and financial performance of small, medium and large trawlers in Goa. Ratios are used to compare the economic indicators of the different size trawlers. A Kruskal-Wallis H test is run to determine if there are differences in the ratios between 3 groups of trawlers namely small, medium and large. The non-parametric test Kruskal Wallis test is used for the different ratios since the ratios did not follow the test of normality. The dependent variables are the different economic indicators and the independent variable is the size of trawlers.

The hypothesis stated is that, *"There is a significant difference between the economic and financial indicators in terms of ratios among the different size of trawlers in Goa".* The null hypothesis proposed is that, *"There is no significant difference between the economic and financial indicators in terms of ratios among the different size of trawlers in Goa".* The results of relationships of the different ratios of all the economic indicators using Kruskal Wallis H test are summarized in table 6.23, as follows:

1. *Input* – Output Efficiency (Cost ratios)

i. *Operating ratio*: The mean rank of the ratios is not statistically significantly different between groups $\chi 2$ (2) =0.27, p=0.87>0.05, at 5% level of significance. The operating ratio shows that more than 75% of the gross revenue was spent by fishermen towards meeting operating expenses, for all sizes of trawlers. The findings of the present study are close to the results of Salim, Aswathy, Vipinkumar, & Geetha, (2014) who observed that 70% of the revenue was spent towards operating expenses by mechanized gillnetters in Chennai.

ii. *Fixed cost ratio*: The mean rank of the ratios is statistically significantly different between groups $\chi 2(2)$=6.01, p=0.04<0.05, at 5% level of significance. The proportion of fixed cost to gross revenue is higher for large trawlers, due to the higher capital investments made on large vessels. In a study by Salim et al. (2014), in Kerala, finds

Table 6.23 Ratio Analysis of Economic Indicators of Efficiency of Trawlers with Respect to Size of Vessel using Kruskall Wallis test

Sl.No	Economic parameters	Size of vessel categories			Kruskal Wallis test		Accept/Reject Hypotheses
		Small Vessel	Medium Vessel	Large Vessel			
		Average	Average	Average	χ2	Asymp. Sig.	
1	**Input –output efficiency (Cost Ratios)**						
i	Operating cost ratio (%)	75.93	76.36	76.40	**0.27**	**0.87**	Accept
ii	Fixed cost ratio (%)	3.59	3.94	5.37	**6.01**	**0.04****	Reject
iii	Gross/ Total cost ratio (%)	79.52	80.30	81.77	**2.60**	**0.27**	Accept
2	**Capital efficiency**						
i	Capital-turnover ratio	2.10	1.11	2.07	**1.01**	**0.60**	Accept
ii	Payback period (years)	2.87	3.35	4.15	**0.87**	**0.64**	Accept
iii	Rate of return on investment(capital) (%)	40.08	36.90	42.86	**0.87**	**0.64**	Accept
3	**Profitability ratios**						
i	Benefit Cost Ratio (BCR)	1.26	1.25	1.23	**2.65**	**0.26**	Accept
ii	Gross profit ratio	23.60	23.64	24.07	**0.27**	**0.87**	Accept
iii	Net profit ratio	18.23	19.70	20.48	**2.60**	**0.27**	Accept
4	**Catch per unit of effort and Labour Efficiency ratios**						
i	Catch per trip /catch per unit of effort (kgs)	121.66	316.88	955.98	**46.75**	**0.00****	Reject
ii	Labour Productivity /Catch per labour in (kgs)	4089.85	3805.55	4480.23	**1.98**	**0.37**	Accept
iii	Labour Productivity(in sales Rs) per man days	11265.22	15119.80	18108.20	**13.17**	**0.001****	Reject
iv	Capital per labour (Rs)	242367.23	254365.64	262228.16	**0.56**	**0.75**	Accept
5	**Cost volume profit analysis(Marginal efficiency)**						
i	Break Even Point (%)	16.08	17.07	24.16	**5.51**	**0.06***	Reject
ii	Profit Volume ratio (%)	23.60	23.64	24.07	**0.27**	**0.87**	Accept
iii	Ratio of MOS (%)	75.84	82.93	83.92	**5.51**	**0.06***	Reject

Note: Variable significant at **5%, *significant at 10% **Source**: Researchers compilation from the data analysis based on primary survey, Averages are used only for comparison.

that for every rupee invested 2.6% was the fixed cost incurred by the gill netters. This is closer to the findings of the present study.

iii. *Total cost ratio*: The mean rank of the ratios is not statistically significantly different between groups χ2 (2) =2.60, *p*=0.27>0.05, at 5% level of significance. The total cost percentage varies from 79% to 82%. The investment in fixed assets, fixed and operating costs incurred is more for large trawlers as compared to small and medium.

2. *Capital efficiency*

i. *Capital turnover ratio*: The mean rank of the ratios was not statistically significantly different between groups $\chi2$ (2)=1.01, p=0.60>0.05, at 5% level of significance. Small trawlers have high capital turnover ratio, the reason being capital investment by small vessels is less as compared to medium and large vessels. Thus, small trawlers recover their capital investment from gross revenue faster than medium and large.

ii. *Payback period* (*in years*): The mean rank of the ratios was not statistically significantly different between groups $\chi2$(2)=0.87, p=0.64>0.05, at 5% level of significance. Small trawlers are found to be more efficient in terms of payback period, because it takes less time, 2.87 years for respondents to recover the capital investments, whereas large trawlers have taken more time 4.15 years to recover the capital investment, the reason being the higher cost of capital investments in fixed assets. However, with the reasonable catch, increasing prices of fish catch, it is possible for all the trawler owners in Goa to recover their capital investment in less than five years.

iii. *Ratio of Return on investment*: The mean rank of the ratios was not statistically significantly different between groups $\chi2$(2)=0.87,p=0.64>0.05, at 5% level of significance. It is evident from the present study that the ratio of return on investment for large trawlers is the highest 42.86%. It implies that for every ₹ 100 invested, there will be a return of 42.86% for large trawlers. The small and large trawlers are financially viable as the owners earn the net profit for reinvestment compared to medium sized trawlers. This results are closer to the findings of the study by Kanaga (2015) who find that the rate of return worked out to 43.4% for mechanized trawlers in Thoothukudi district in Tamil Nadu.

3. *Profitability ratios*:

i. *Benefit Cost Ratio* (BCR): The mean rank of the ratios was not statistically significantly different between groups $\chi2$ (2)=2.65, p=0.26>0.05, at 5% level of significance. In the present analysis, fishing is profitable and feasible since the BCR recorded a value of more than one for all sizes of trawlers. All the sizes of trawlers are financially viable. The results of the present study is closer to the study of Tunde et al. (2015) who claims that the BCR of 1.9 for fish farming is found to be profitable.

ii. *Gross profit ratio*: The mean rank of the ratios was not statistically significantly different between groups $\chi 2$ (2) =0.27, p=0.87>0.05, at 5% level of significance. The gross profit ratio of larger trawlers was found to be higher than medium and small trawlers, the reason being the higher quantity of catch and earnings from sales for large size trawlers. However, there is no major variation in gross profit among all the sizes of trawlers.

iii. *Net profit ratio*: The mean rank of the ratios was not statistically significantly different between groups $\chi 2(2)$=2.60, p=0.27>0.05, at 5% level of significance. A higher net profit ratio will help the trawler owners to run their business efficiently. According to Lery, Prado, & Tietze, (1999) a net profit ratio of more than 10% can be considered as good. In the present study it is found that net profit percentage was higher for large size vessels. However, the percentage of net profit was above 10% for all size trawlers. This shows that all the types of vessels were financially viable and can recover their operating and fixed costs.

4. *Efficiency Ratios*

i. *The catch (in kgs) per trip*: The mean rank of the ratios was statistically significantly different between groups $\chi 2(2)$ =46.75, p=0.000<0.05, at 5% level of significance. The catch (in kgs) per trip is more for large trawlers as they go for deep sea fishing bringing more catch. Catch per trip is statistically significant for all the sizes of trawlers.

ii.*Labour Productivity (in kgs)*: The mean rank of the ratios is not statistically significantly different between groups $\chi 2(2)$=1.98, p=0.37>0.05, at 5% level of significance. In terms of labour productivity large vessels proved to be more efficient. The average number of labourers employed is more on large trawlers as compared to small and medium, which invariably helps to increase the labour productivity. The number of crew employed on the trawlers is in proportion to the size of the vessels.

iii.*Labour Productivity per man-days*: The mean rank of the ratios was not statistically significantly different between groups $\chi 2$ (2) =13.17, p=0.001<0.05, at 5% level of significance. The gross revenue earned per labour by the owners of large trawlers is more than the small and medium. Thus, large trawlers have proved to be efficient in terms of labour and have further scope for increasing labour on the vessel, as more manpower helps in carrying out fishing operations effectively. The large trawlers are economically viable and provide more employment to the labour in Goa.

iv. *Capital per labour*: The mean rank of the ratios was not statistically significantly different between groups $\chi2(2) = 0.56$, $p=0.75>0.05$, at 5% level of significance. The capital invested by the trawler owners per labour is higher for large trawlers, and they also employ more labourers as compared to the small and medium trawlers.

5. *Cost volume profit analysis* (*Marginal Efficiency*)

i. *Break even sales* (*percentage*): The mean rank of the ratios was not statistically significantly different between groups $\chi2(2) = 5.51$, $p=0.06<0.10$, at 10% level of significance. It is used to examine whether the trawlers can survive and sustain in business. In the study, it was found that the respondents who own large trawlers had higher break even percentage as compared to the small and medium trawlers, due to higher earnings by larger vessels.

ii. *Profit volume ratio*: The mean rank of the ratios was not statistically significantly different between groups $\chi2(2) = 0.27$, $p=0.87>0.05$ at 5% level of significance. The profit volume ratio of large trawlers is more than the small and medium trawlers. Thus, large trawlers are more viable than the small and medium.

iii. *Margin of safety* (*in percentage*): The mean rank of the ratios was statistically significantly different between groups, $\chi2(2) = 5.51$, $p=0.06<0.10$, at 10% level of significance. The margin of safety is higher for large trawlers as compared to the small and medium trawlers.

The overall results of all the ratios discussed in table 6.23, reveals that the input output ratio was high due to high operational costs for all the size of trawlers. In line with review of literature, higher the operating ratio lower is the capital productivity. Capital efficiency was high as respondents could recover the capital investments on the trawlers. The profitability ratio was found to be 10%, which indicated that the respondents earned reasonable profits from the trawl fishing business. Labour productivity (efficiency) was found to be higher for large size trawlers as compared to small and medium. Marginal efficiency was high as all sized trawlers achieved the break even sales. However, the highest break even percentage was found for the large size trawlers. The trawler owners will be able to run the trawlers provided they recover the operating and fixed costs. In the study area, most of the trawlers were running into reasonable profits for the period 2016-17 as revealed by the ratios.

6.4 Summary

The present study is carried out to analyze the economic efficiency of the trawlers used for fishing business in Goa. The analysis of capital investment, costs incurred, earnings, and profit shows that there are variations in capital investments, costs, earnings and profit across the different sizes of trawlers and jetties in Goa. The one way ANOVA tests results shows that gross profit and net profit per trip for trawlers is significant across the size of trawlers and jetties in Goa. It is evident from the study that the respondents invest more amount on the hull of the trawlers. However, reconditioning is also a major capital cost for small and medium aged trawlers. Depreciation is a major element of fixed costs for all the sizes of vessels. The findings of the study also indicate that expenditure on fuel is a major component of the total operating costs ranging between 40-50% for all the sizes of vessels. The respondents stated that 100% VAT reimbursement subsidy received on fuel from the government was inadequate, due to the continuous increasing prices of cost of fuel. In this regard, it is suggested that Government has to retain 100 % VAT reimbursement fuel subsidy.

The results of the multiple regression model shows that the variables viz. gender and educational qualification has impact on the net profit. The variable, financial status poverty line index has impact on the earnings from trawl fishing business. The variables, financial status poverty line index and educational qualification has also an impact on the respondents savings from the fishing business. In case of linear regression model, the variable district North Goa had impact on the net profit, earnings but had no impact on the savings of fishermen. The log-log model of multiple regression using Cobb Douglas production function theory indicated that the variables, horse power of vessel, wages paid to labour and fishing hours had positive impact on the earnings. The production function using Cobb Douglas theory indicated that there is an ample scope for the respondents to increase their earnings from fishing business by increasing the productive fishing hours, investing in higher engine horsepower and employing skilled and experienced labourers.

The ratio analysis used to study the economic and financial performance of the trawlers indicated that the large size trawlers in Goa were more viable fishing units, when compared with the small and medium sized trawlers. There is further scope for the respondents owning small and medium trawlers to enhance their gross revenue, if they replace their small and medium into large sized trawlers. The respondents generate reasonable revenue to cover fixed and variable costs. However, the high percentage of operational costs is compensated by the trawler owners only due to continuing increase in the fish prices of quality species of fish. Based on the findings of the study, the following policy recommendations are made. The policy intervention of the Government of Goa, through Fisheries Department could ensure easy credit facilities to the fishermen in Goa. Government could provide interest free loan facilities to the trawler owners to meet their financial requirement of fishing business activities to some extent.

This chapter provides a holistic view of the capital investments, costs, earning and profits of the trawlers in Goa. The next chapter analyses the cost, earnings and profit of the Purse-seine vessels in Goa as they contribute immensely to the marine production and exports of the fishing industry of Goa.

Chapter 7

An Analysis of Cost, Earnings and Profit of Purse-seine Vessels of Fishing Business in Goa

Chapter 7

An Analysis of Cost, Earnings and Profit of Purse-seine Vessels of Fishing Business in Goa

7.1 Introduction

Purse-seining is a method to capture large shoals of pelagic fish close to the surface such as sardines, mackerals, tuna, anchovies, herring, salmon and demersal fish such as prawns by encircling them with a large purse-seine net (Kamble, Chaudhari, Shirdhankar, & Markad, 2013). The purse-seine vessels are equipped with purse-seine nets as well as dingy boats (small boats) and hence they are called as purse-seiners. Purse-seine fishing as an important bulk catching method was first evolved in the Atlantic coast during the last quarter of the 19th century. In India, purse-seining was initiated by the Indo-Norwegian Project in 1953 and the operations on commercial lines were taken up from 1976 onwards (Mukundan & Hameed, 1980). In 1979, purse-seine fishing was later introduced into the commercial fishing, in the states of Karnataka, Kerala and others. Purse-seine fishing has developed and changed rapidly due to increase in size of vessels, increase in purse-seine nets, increase in horsepower of engines and multiday fishing (Mohamed et al., 1998). However, the state of Goa was the first state to start the commercial activity of purse-seine fishing on an experimental basis in 1957 by changing from rampon nets to purse-seine nets when the union territory of Goa was under the Portuguese rule (Sadanandan, K.Kunjipalu, George, & Mathai, 1975); (Desai, Sharangdhar, & Mohite, 2016). After liberation, purse-seine fishing was successfully commercialized in Goa in 1964, with only two purse-seiners under operation. In the year 1969, the number of purse-seiners in Goa increased to 42 which were only 4 in 1961. In 1992, the number of purse-seiners considerably increased to 225. During 1991-1992, the total marine fish landings of Goa was estimated at about 96,000 tonnes, of which the contribution of purse-seine contribution was about 75% of the marine fish landings (Panikkar, Sehara, & Kanakkan, 1994). There were 301 purse-seine vessels operating on Goa's coast for the financial year 2016-17. In Goa purse-seine fishing activity is carried out on three jetties namely; Cutbona, Malim and Vasco ("*Khariwada")*. Purse-seining is carried in Goa throughout the fishing season from August to May but the activities are intense during August to November when oil sardines and Indian mackerels are available in large shoals.

There were several studies conducted in various countries of the world and in India on the economic as well as commercial aspects of purse-seine fishing. Nguyen and Nguyen (2010) studied factors affecting revenue of trawling and light purse-seining vessels in Ben Tre province, in Vietnam by using a multivariate regression model. The results showed that single boat trawlers achieved the highest return on investment (ROI) followed by pair trawlers and light purse-seiners. Factors such as size of the vessel, capacity of the engine, captain’s experience, fishing gears, and life of the vessel have considerable effects on the revenue of single-boat trawlers and light purse-seine vessels. A study by Pattanayak (1988) on purse-seine fishing in the coastal state of Karnataka, found that 398 purse-seine fishing fleet were introduced in in the mid-seventies in the state and the total marine production during 1987-88 increased to 1,29,659 tonnes, valued at ₹ 48.05 crores. However, a study by Dhulkhed & Bhat (1985) on purse-seine fishing, at Mangalore, Malpe, and Gangolli, from 1976-1981 showed that the oil sardine fish count in the sea has declined due to the use of severe harsh fishing techniques such as the purse-seine fishing gears. Another study on socio-economic characteristics by R. Narayana Kumar, & K.K.P. Panikkar (2000), conducted in 1981 to study the impact of purse-seine operations on the indigenous fisheries, indicated that heavy landings by purse-seine vessels at Cochin and Mangalore had affected the catch of the country crafts.

A study by Panikkar, Sehara, & Kanakkan (1994) in Goa on purse-seining in 1991-92 shows that the average profit for a single purse-seine vessel worked out at ₹ 1.19 lakhs and the rate of return was 34%. The Directorate of Planning, Statistics and Evaluation, Panaji (2007) reported that in 2006 there were 350 purse-seine vessels in Goa. The same report stated that there was fish depletion in Goa on account of destruction of breeding grounds due to over exploitation, fishing during breeding season, wastage due to discarding of low value fish. This report also indicated that the destruction of the breeding grounds adversely affects the commerce of fishing industry. A study by Gaonkar, Rodrigues, & Patil (2008) on the economic analysis of purse-seine boats in Goa in 2004 by using variables such as fixed costs, variable costs, gross revenue and gross profit of purse-seine boats, finds that the purse-seine boats were running into profits in Goa. Analysis of the above literature shows that studies have been conducted on the economic analysis on mechanized purse-seine fishing both in India and the world. However, the researcher could not find research on the costs and earnings on purse-seine vessels in Goa since 2004 onwards. The present study is an attempt to fill this research gap.

The objective of this chapter is to compare and examine the costs, earnings and profits of medium and large sized 73 purse-seine vessels operated by the fishermen across the three jetties in Goa namely, Malim, Vasco and Cutbona for the fishing season August 2016 to May 2017. The objective of the study is to examine the variation in capital investments, costs, earnings and profits among different categories of mechanized purse-seine vessels (medium and large) owned by the fishermen in Goa. The commercial and economics of purse-seine fishing is studied under the different heads, namely; capital investments, fixed costs, operating costs, gross revenue (earnings), gross and net profit from purse-seine business in Goa. The cost structure (comprising of capital investments, operational and fixed costs) and earnings are compared across the size of purse-seine vessels and jetties in order to examine the impact of costs and earnings on the profitability of the purse-seine vessels. This study explores the economic and financial performance of the purse-seine fishing vessels in Goa. The economic indicators are used to assess the costs, earnings and profits of purse-seiners in Goa. The economic efficiency (performance) is an important indicator to decide the viability of the purse-seine vessels. The economic effeciency of the purse-seine vessels will be assessed by using different economic and financial indicators as tools of measurement. The economic indicators such as input and output analysis and financial performance are assessed through the rate of return on investment. The economic and financial performance indicators are compared between the sizes of purse-seine vessels (medium and large) and across the jetties. The activity of purse-seining requires huge capital investment in fixed assets, operating costs and fixed costs. Hence, an assessment into the costs and profits is done in the present study to examine whether purse-seine fishing business is economically viable for the fishermen owning purse-seine vessels in Goa. Analysis of the viability of the purse-seine vessels will help the owners to decide whether to continue or quit the fishing business. There is also a need to study impact of the input of factors of production on the earnings from fish catch. The sub-objectives of the study are to examine the impact of socio-economic factors on the net profit, earnings and savings from fishing business.

The costs, earnings and profit analysis of purse-seine vessels will help the fishers to understand whether they can attain profits despite high operating costs? Another research question involved was whether there is a variation in capital investments, costs, earnings and profits among the different levels (means different size vessels, medium and large) purse-seine vessels in Goa? and if so? Are the variations in capital investments, costs, earnings and profits of purse-seine vessels due to differences in the input combinations? These are the issues involved in this study. Keeping this in mind, in the present study, an attempt is made to make an assessment of the capital investments, costs, earnings and profits of purse-seine fishing business operated across the three jetties in the two districts of Goa. There is a need to investigate whether the purse-seine vessels are economically feasible for the fishers in Goa. It is against this background; this study explores the economic and financial performance of the purse-seine vessels as they are important aspects for the fishermen in Goa.

7.2 Data Sources and Techniques

The study uses primary data collected using a structured interview schedule administered to fishermen owning 73 purse-seine vessels in Goa. The interview is conducted by researcher for the entire fishing season during the period from August 2016 to May 2017 using simple random sampling method. The data is collected from fishermen owning purse-seine vessels from the talukas namely, Tiswadi and Bardez, who operate their purse-seine fishing vessels from Malim jetty in North Goa. In South Goa, the purse-seine vessels operate on Vasco (*Khariwada*) and Cutbona jetties, which are located in Mormugao and Salcete talukas. Since, purse-seine vessels are operational and purse-seining activity is carried out on all the three jetties, hence they were considered for the study. The interview with the fishers on these jetties helped in the collection of data regarding economic and commercial aspects of purse-seine vessels operational in Goa.

7.2.1 Sample Size and Classification of Purse-seine Vessels

The Salant and Dillman (2007) method is used to calculate the sample size as shown in table 7.1. The sample consists of the fishermen owning medium and large purse-seine vessels and which use purse-seine method of fishing. On the basis of

Table 7.1 Sample Size of Mechanized Purse-seine Vessel Owners

Talukas and Jetties	Operational purse-seine vessels (Population)	Respondents owning Purse-seine vessels surveyed (Sample)	Percentage of respondents owning operational purse-seine vessels surveyed
NORTH GOA			
Bardez (Malim Jetty)	75	17	22.66
Total North Goa	75	17	22.66
SOUTH GOA			
Mormugao (Vasco/*Khariwada* Jetty)	61	17	27.86
Salcete (Cutbona Jetty)	165	39	23.63
Total South Goa	226	56	24.77
Total	**301**	**73**	**24.25**

Note: Based on Salant & Dillman(2007) method at 10% error 50/50 split ie. upto population 250, sample size is required is 70 but sample size taken for study is 73, (73/301*100=24.25%), **Source:** Researchers compilation from the data of Department of Fisheries, Goa regarding number of purse-seine vessels.

Government guidelines, the fishermen owning purse-seine vessels have benchmarked their vessels as shown in table 7.2. The size of the mechanized vessels allowed by the Government of Goa is upto 75 feet i.e 23 m. The classification given in table 7.2 regarding fishing operations of purse-seine vessels in Goa is used for the present study. The researcher also classified the purse-seine vessels into medium and large

Table 7.2 Technical and Operational Characteristics of Purse-seine vessels

Size of mechanized fishing vessels (Purse-seiners)	Size in feet	Overall Length in meters	No of Cylinders	Horsepower of engine	Number of vessels surveyed	Number of fishing days
Medium	46-60ft	14.76-18.46	6	98-210	46	1-5days
Large	61-75ft	18.76- 23	6 and 8	210-300	27	8-15days

Source: Researchers compilation from the primary survey.

after consulting the technicians and the respondents. The purse-seine vessels were grouped into two categories measured in terms of feet/metres, overall length, cylinders, horsepower of the vessel and the number of fishing days. In the sample, the researcher could find purse-seine vessels of overall length (OAL) varying from 48-75ft with engine capacities varying from 98-300 horsepower. Large size vessels ranging between 65-75 feet are mostly concentrated on Malim and Cutbona jetties, though Vasco jetty has a few large size vessels, but on the whole it has more medium vessels. However, in the study area, it is observed that in the recent years most of the respondents are investing in building large size steel vessels. These purse-seine vessels are fitted with inboard engines and use the purse-seine fishing gears (nets) for fishing operations. The length of the fishing gear depends on the horsepower of the engine and size of the vessel. The mesh size of purse-seine gears used in Goa is between 18-46 mm. The length of the purse-seine net for medium sized vessels varies between 400-600m, depth of gear varies between 40-50m. For large size vessels the length of gear ranges between 700-1000 m and depth of purse-seine net is 60-90 m.

The variables and statistical tools employed in the present study are mentioned in Research Methodology chapter section 3.6 and 3.8 respectively.

7.3 Results and Interpretation

This study examines the profitability of purse-seine vessels in the study area from the point of capital investments, cost incurred and the earnings made from purse-seining business by the owners of these vessels. The empirical data on the capital investments, costs and earnings of purse-seine fishing vessels is analyzed for the three jetties, and the results and findings obtained are tabulated and explained in the following sections from 7.3.1 to 7.4, whereas section 7.5 provides the summary.

7.3.1 Number of Mechanized Purse-seine Vessels Owned by the Respondents

Table 7.3 shows that in both the districts, majority of the respondents are having two purse-seine vessels registered in their names. As regards the nature of

Table 7.3 Taluka-wise Total number of Purse-seine Vessels

Coastal Talukas	Total vessels owned per family of respondents							
	1	2	3	4	5	6	7	Total
Tiswadi	(1.40)	(8.20)	(1.30)	(1.40)	0.00	0.00	0.00	(12.30)
Bardez	(1.40)	(4.10)	0.00	(4.10)	(1.40)	0.00	0.00	(11.00)
North Goa	**(2.80)**	**(12.30)**	**(1.30)**	**(5.50)**	**(1.40)**	**0.00**	**0.00**	**(23.30)**
Mormugao	(6.80)	(9.60)	(4.10)	0.00	0.00	(1.40)	(1.40)	(23.30)
Salcete	(21.90)	(16.40)	(9.60)	(4.10)	0.00	0.00	(1.40)	(53.40)
South Goa	**(28.70)**	**(26.00)**	**(13.70)**	**(4.10)**	**0.00**	**(1.40)**	**(2.80)**	**(76.70)**
Total	**(31.50)**	**(38.30)**	**(15.00)**	**(9.60)**	**(1.40)**	**(1.40)**	**(2.80)**	**(100.00)**

Note: Figures in (parenthesis) represents percentages to the total**, Source:** Researchers compilation from the data analysis based on primary survey.

ownership, majority of the fishermen (96%) in both the districts are ambitious to own purse-seine vessels in their names and only 4% have entered into a partnership. This result is in line with the findings of Suryawanshi et al. (2014) who finds that 95.40%

fishermen owned vessels on their names and 4.60% were operating on partnership basis. In the present study, the respondents have experienced problems while entering into partnership in purse-seine business and hence majority of them preferred to remain as sole proprietors. Most of the respondents (76.7%) have purchased vessels, 20.5% are inherited and 2.7% have entered into a partnership. Majority of the respondents have purchased new vessels or have built new ones. However, some of the respondents have purchased second-hand vessels and have registered them in their names.

7.3.2 Jetty-wise Disposition of Marine Fish Catch by Purse-seine Owners

Table 7.4, depicts that in Goa, disposition of fish catch is done through marketing. The unsold fish is salted and sundried for future sale. The different modes adopted by the fishermen in marketing of fish are they sell it in wholesale and retail markets of Goa. Fish is also sold to wholesale agents, fish vendors, fish meal plants, and to factories involved in processing and exporting it to foreign countries. It is also sent to other states of India such as Kerala, Maharashtra, Karnataka and other states.

Table 7.4 Jetty-wise Disposition of Marine Fish Catch by Fishermen Owning Purse-seine Vessels

Jetties	Disposition of marine fish catch		
	Salted and Sundried	Marketing	Total
Malim	(5.00)	(23.30)	(23.30)
North Goa	**(5.00)**	**(23.30)**	**(23.30)**
Vasco (*Khariwada*)	(6.00)	(23.30)	(23.30)
Cutbona	(27.30)	(53.40)	(53.40)
South Goa	**(38.30)**	**(76.70)**	**(76.70)**
Total	**(38.30)**	**(100.00)**	**(100.00)**

Note: Figures in (parenthesis) represents percentages to the total**, Source:** Researchers compilation from the data analysis based on primary survey.

Majority of the respondents do not auction their fish catch but sell it to the fish trade agents at the jetties depending on the price negotiated between them. The price of fish varies continuously at a jetty itself, depending on the quality and size of species of fish. Agents normally buy the fish catch in bulk from the respondents and sell it to the fish vendors, send it to other states and export it to other countries. The respondents also send low priced catch i.e. scrap fish to fish meal plants. The respondents also sell highly priced catch to factories in Goa who will then export it. In South Goa, on Cutbona jetty and also at Colva village, there are facilities available for salting and sun drying the fish. However, there are no salting and sun drying facilities available on Vasco and Malim jetties. The respondents in Vasco and Malim jetties salt and sundry the fish catch in limited space available on these jetties. Government has to provide infrastructure and make provision for salting and drying the fish on Malim and Vasco jetties.

Section 7.3.3 analyses the average number of labourers employed on different sizes of purse-seine vessels.

7.3.3 Size of Purse-seine Vessels and Average number of Labourers Employed

Table 7.5 shows that fishermen owning purse-seine vessels employ more labourers as compared to motorized canoes and trawlers. The reason is on purse-seine vessels, purse-seine nets are used which require more manpower to pull the net. The medium sized purse-seine vessels require on an average 25 employees per vessel. The

Table 7.5 Average Number of Labourers Employed on Purse-seine Vessels

Size of vessel category	Total employees employed			Goan employees			Migrant employees		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Medium	25	16	35	1	1	3	26	16	35
Large	31	19	41	1	1	3	31	19	40

Source: Researchers compilation from the data analysis based on primary survey.

large vessels employ on an average employees ranging from 26-40. The crew size is also in proportion to the size of the vessel. Majority of the respondents provide food, medical reimbursement, compensation and other benefits to the employees. The miscellaneous expenses of the crew are also borne by the vessel owners. Most of the employees stay on board and hence there is no necessity of providing accommodation facilities to them. Some respondents also ensure to do medical insurance policy for their employees for every fishing season. Fishermen contribute an amount of ₹ 200 per crew and per owner for entire fishing season towards corpus fund to the government.

The next discussion given in section 7.3.4 shows the net profit earned from fishing business, savings and household expenditure of the respondents.

7.3.4 Net profit, Savings and Liabilities from the Purse-seine Fishing Business

The Independent Sample *t*-test is conducted to analyse whether there is a significant differences between the five dependent variables viz. namely, X_1 mean of net profit of single vessel, X_2 mean of net profit from more than one vessel, X_3 mean of savings from fishing business, X_4 mean of liabilities from fishing, and X_5 mean of household expenditure of the fishermen owning purse-seine vessels. The independent variable used is the districts. The mean of net profit of a single vessel, the mean of savings, and the mean of household expenditure is compared of 17 respondents in North Goa with 56 in South Goa. However, the mean net profit of more than one vessel is compared of 14 respondents in North Goa with 35 respondents in South Goa. As per the null hypothesis, it is stated that, *"There is no significant difference between mean net profit of single vessel, the mean of net profit of more than one vessel, mean savings from fishing, mean of liabilities, and mean household expenditure of the fishermen owning purse-seine vessels among the districts"*.

The results given in table 7.6 shows that there is a significant difference between the mean of net profit of respondents owning a single vessel, (t =-3.81, p=<0.05), and mean of savings from fishing business, (t=-3.10, p=0.007<0.05), in the

Table 7.6 Results of Independent Sample *t*-test of Purse-seine Fishing

Variables	Districts		Independent sample *t* –test		Significance
	North Goa	South Goa			
	Mean (₹)	Mean(₹)	*t*-value	Sig	
X_1 Net profit of single purse-seine vessel	846687_a	1801268_b	-3.81	0.00**	Significant
X_2 Net profit of more than one purse-seine vessel	$29{,}98{,}571_a$	$39{,}25{,}000_a$	1.18	0.24	Not significant
X_3 Savings from fishing p. a.	347059_b	705277_a	-3.10	0.007**	Significant
X_4 Liabilities from fishing business	$21{,}11{,}111_a$	$13{,}69{,}306_a$	1.21	0.23	Not Significant
X_5 Household expenditure p.a.	$4{,}62{,}000_a$	$4{,}07{,}571_a$	1.05	0.29	Not Significant

Note: **Variable significant at 5 %, the subscript "a, a" means there is no significant difference, whereas "a,b", means there is a significant difference, **Source:** Researchers compilation from the data analysis based on primary survey.

two districts. Thus, the null hypothesis is rejected. The mean difference in the net profit of single purse-seine vessel is more by ₹ 954,581 in South Goa as compared to North Goa. The mean difference in the savings from purse-seine fishing is more by ₹ 358,218 in North Goa as compared to South Goa. The reason for the significant difference is that in South Goa, on Cutbona jetty majority of the respondents have large size vessels. Besides, this the fish catch of respondents of Cutbona jetty in South Goa is more than that of the respondents of Vasco and Malim jetties. This helps them to get more earnings, resulting in more net profit and savings as compared to respondents from Vasco and Malim jetties. However, there are no significant differences in the mean of net profit of more than one vessel, mean liabilities of fishing and mean household expenditure of the respondents in both the districts. Thus, from the testing of the hypothesis, it can be inferred that there are significant differences in the mean of net profit of respondents owning a single vessel and savings among the respondents of the two districts. The analysis on financial aspects of investment, cost, gross revenue and profit is given in section 7.3.5.

7.3.5 Investment, Cost, and Profit Analysis of Purse-seine Fishing Business

The objective of section 7.3.5 is to analyse the capital investment, cost, gross reveue (earnings) and profits of different sizes of vessels (medium and larger). This analysis is aimed at understanding whether the differences in capital investments among the purse-seine vessels will affect their operating and fixed costs, earnings and profits from the fishing business. The section 7.3.5.1 to 7.3.5.7 explains the analysis of the sources of finance, investment in fixed assets, fixed and operating costs incurred, gross revenue (earnings) and profit earned by the fishermen owning purse-seine vessels.

7.3.5.1 Sources of Finance by Purse-seine Owners

Table 7.7 shows that all the 73 respondents have availed credit through formal and informal sources of finance for carrying out fishing activities in Goa. Formal

Table 7.7 Sources of Loan taken by Fishermen Owning Purse-seine Vessels

Jetty	Sources of loan			
	Bank	Relatives	Friends	Fish traders(Agents)
Malim	(23.3)	(5.5)	0	(9.6)
North Goa	**(23.3)**	**(5.5)**	**0**	**(9.6)**
Vasco (*Khariwada*)	(20.5)	(6.8)	(5.5)	(17.8)
Cutbona	(46.6)	(17.8)	(5.5)	(49.3)
South Goa	**(67.1)**	**(24.7)**	**(11)**	**(67.1)**
Total	**(90.4)**	**(30.1)**	**(11)**	**(76.7)**

Note: Figures (in parenthesis) indicates percentages, **Source:** Researcher's compilation from the data analysis based on primary survey

sources of credit are banks whereas informal sources are relatives, friends, and fish trade wholesale agents. The analysis from the survey shows that majority (90.4%) of the respondents have taken loan from banks followed by advances from fish trade agents 76.7%. The major purpose of taking loan is to build/purchase the fishing vessels, fishing gears, reconditioning of vessels, incur operating, fixed cost and other expenses. The respondents are attracted to the non-institutional agencies due to the simple procedures, instant and informal finance for meeting their operational and other expenses. The money lenders are the wholesale agents dealing in fish trade who provide finance to the fishers to meet their financial requirements. The respondents stated that they need not pay interest to fish traders (agents), relatives and friends and borrowing is easier from these sources as there are no formalities involved, unlike banks which insist on surety and loan guarantor. Instead of taking interest on the borrowed amount, fish trader agents buy the fish catch from the respondents for less than the actual price per kilogram. These circumstances lead to a situation where the agents get maximum profit out of the hard work of the fishermen. Since the fishers borrow from the agents, they are compelled to sell their catch to the agents at a lower price i.e 10-15% less than the actual sale price prevailing in the market, in order to pay their loan liability. It is recommended that the Fisheries Department should create awareness amongst the fishermen and encourage them to take loans from public sector commercial banks rather than be dependent on advances from fish trade agents, in order to earn more income on their catch. A study by Vipinkumar V. P., B. Johnson, P. S. Swathilekshmi, & C. Ramachandran, (2013) showed that among fishermen, the micro finance institutions ranked better in most of the attributes in the perception of stakeholders compared to commercial banks and non-institutional credit sources.

It is evident from table 7.8 that the respondents in both the districts of Goa tend to use more percentage of own money as compared to borrowed funds for investment in the fishing business. Respondents at Vasco jetty have used the highest percentage of their own money compared to loan, whereas the contrary is observed at Cutbona jetty. Majority of the respondents at Malim and Cutbona jetties have invested in large sized steel purse-seine vessels and a few have invested in the purchase of insulated trucks for marketing of fish in other states of India. Most of the respondents at Malim and Cutbona and a few at Vasco jetties have availed the subsidy from Marine Products Exports Development Authority (MPEDA) Goa, to purchase insulated trucks for transporting fish to other states. The Government also provides

Table 7.8 Sources of Finance of Capital Investments by Purse-seine Owners

Jetties	Size of vessel	Average loan taken for fishing equipment (₹)	Average of own money spent for purchase of fishing equipment (₹)	Total
Malim	Medium	1570000	3075000	**4645000 (100)**
		(33.80)	**(66.20)**	
	Large	2857143	7035714	**9892857 (100)**
		(28.88)	**(71.12)**	
Vasco (*Kharivada*)	Medium	1070000	3510000	**4580000 (100)**
		(23.36)	**(76.64)**	
	Large	2328571	6257857	**8586428 (100)**
		(27.12)	**(72.88)**	
Cutbona	Medium	1871739	3416522	**5288261 (100)**
		(35.39)	**(64.61)**	
	Large	3723077	7592308	**11315385 (100)**
		(32.90)	**(67.10)**	

Note: Figures (in parenthesis) represents the proportion of mean percentage to the total. **Source:** Researcher's compilation from the data analysis based on primary survey.

agricultural loans up to ₹ 5,00,000 at 4% interest per annum for fishing activities. Many of the respondents have availed these loans, but they feel that the amount is not adequate to meet their fishing requirements.

7.3.5.2 Analysis of Credit Facilities for Purse-seine Owners

It is evident from table 7.9, that in both the districts almost 73.95 % had cleared their loans with the banks within the time limit. Commercial banks normally give loans for fishing business for a period of seven years; however, respondents paid

Table 7.9 Jetty-wise Analysis of Credit of Purse-seine Owners

Jetties	Average number of years of loan	Average loan for the vessel (₹)	Average interest amount (₹)	Average rate of interest (%)	Loan paid (%)	
					No	Yes
Malim	5	2100000	380000	12.12	5.47	17.80
North Goa	**5**	**2100000**	**380000**	**12.12**	**5.47**	**17.80**
Vasco	5	1588235	224400	11.51	8.20	15.06
Cutbona	5	2458462	393500	11.56	12.30	41.09
South Goa	**5**	**2194286**	**328462**	**11.54**	**20.50**	**56.15**

Source: Researcher's compilation from the data analysis based on primary survey.

the loans on an average of five years. The average loan obtained by respondents at Cutbona jetty is the highest as most of the respondents have purchased large size steel vessels i.e from 65 feet to 75 feet as well as insulated trucks.

The next section 7.3.5.3 to 7.3.5.7 discusses about the capital investments, fixed cost, operating costs, factors affecting purse-seining and profits earned by the respondents in purse-seining business. The results of Independent sample *t*- test across size of vessels and one way ANOVA test across jetties in respect of capital investment, fixed cost, operating costs, and profits is discussed from section 7.3.5.3 to 7.3.5.7. The results of ANOVA test across the jetties are given in the appendix Table 7A to 7E.

The analysis on capital investments in fixed assets of purse-seine vessels and other fishing equipment is important as it helps the respondents to assess their investments in fishing business.

7.3.5.3 Capital Investments in Fixed Assets of Purse-seine Vessels

Capital investments across the size of the vessels and the jetties are taken to examine whether there are significant differences among them. In the study area, all the three jetties had purse-seine vessels with wooden and steel hulls, but a majority of the large size vessels with steel hulls were found on Malim and Cutbona and a few on Vasco jetties. According to the respondent's views, wooden hull vessels are expensive for repair and maintenance compared to steel hulls. Respondents prefer steel hulls due to easy availability. They also stated that since skilled carpenters are not available and availability of good quality wood is a problem, most of them prefer to invest in steel vessels. The new steel purse-seine vessels above 60 feet have better facilities as compared to the wooden vessels. However, according to the respondent's views, vessels with wooden hull has an average life between 30-35 years as compared to steel hulls which has an average life of 15-20 years provided the owners do regular repair and maintenance of their vessels. The total fixed capital cost of investment incurred for acquisition of a purse-seine fishing vessel is the sum of the price of the hull, stern gear engine, winch, amount spent to modify vessel, reconditioning, cost of fishing gear (purse-seine net), mast and other electronic equipment such as fish finders, compass, short and long distance communication equipment. All purse-seine vessels are equipped with fish holds as storage equipment to store ice and fish catch. All the purse-seine vessels use a small dinky boat which is operated by two labourers know as dingy man and the purse-seine net is operated through the dingy boat as well as the purse-seine vessel.

According to FAO, the power block was introduced in 1950, and it is a mechanized pulley used by purse-seine vessels to haul the nets. Purse-seine power block machine works on hydraulic system and is used to cast the net. The purse-seine net is pulled through power block, this reduces the manpower to some extent, but labour is a necessity, despite power block. The purse-seine vessel with the help of labour and power block pulls the purse-seine net taking the fish from the net on board. In the study area, most of the fishermen owning large size purse-seine vessels have installed power block, whereas in case of medium vessels few respondents have installed power block. A study by Pravin and Meenakumari (2016) maintains that the use of power block for hauling the purse-seine net enhances the fishing effectiveness, and reduces the drudgery of the crew on board.

The respondents stated that during the last ten years the cost price of the purse-seine vessel has escalated. The cost of the new purse-seine vessel between 65 to 75 feet in 2016-17 with all accessories and equipment would cost between ₹1,00,00,000-₹ 1,50,00,000. A study by Aswathy, Shanmugam, and Sathiadhas (2011) reported that the capital investment by fishermen owning mechanized purse-seine vessels in Kerala ranged between ₹ 35,00,000 to ₹ 45,00,000. The independent sample *t*-test was used to examine the statistical relation of capital investment across the size of the vessels. The dependent variable is capital investment in fixed assets and the independent variable is the size of the vessel.

As per the null hypothesis it is stated that, *"Across the size of vessels there is no significant difference between the average investments in fixed assets of purse-seine vessels"*. The same hypothesis is checked across jetties and the results are given in Appendix table 7A, taking jetties as an independent variable. Table 7.10 presents the results of the independent sample *t*-test which shows that the variables mean of cost of the hull, purse-seine net and reconditioning, form the significant components of total capital invested. The results show that 35% to 42% of the total investments in fixed assets is spent on the hull and 21.57% to 32.62% is spent on fishing gear (purse-seine net) itself. The investment on reconditioning/refitting on vessels ranges from 15.20% to 15.86%. The present study indicated that the cost of the hull and the fishing gears were the major items contributing to the total capital cost, followed by cost of reconditioning. The result is in consistent with the findings of Kamble et al. (2013) who finds that the cost of fishing net was 37% and cost of hull as 39% of the total capital cost. The results of the Independent sample *t*-test have shown that a statistically significant relation is found between the mean value of the variable cost of hull of against the size of the purse-seine vessel, $t(2,71)=-5.10$, $p=0.00< 0.05$), and hence the null hypothesis is rejected at 5% level of significance. There is statistically significant relation in case of the mean value of variable reconditioning against the

Table 7.10 Results of Independent Sample *t*-test of the Average Cost of Capital Investments in Fixed Assets against the Size of the Purse-seine Vessels

Variables (Capital investments in fixed assets)	**Size of vessel category**		**Independent sample t-test**	
	Medium vessel	**Large vessel**		
	Mean (₹)	**Mean (₹)**	***t*-value**	**Sig**
Hull	2385174_a **(35.19)**	5039630_b **(42.06)**	-5.10	0.00**
Engine and winch	669128_a **(9.87)**	1494167_b **(12.47)**	-5.46	0.00**
Amount to modify the vessel	262674_a **(3.88)**	638981_b **(5.33)**	-5.52	0.00**
Reconditioning of vessel	1030000_a **(15.20)**	1900000_b **(15.86)**	-2.05	0.06*
Total cost of fishing gears (net)	2210465_a **(32.62)**	2585185_b **(21.57)**	-2.42	0.01**
Lifesaving safety and fire fighting equipment	47000_a **(0.69)**	54438_a **(0.45)**	0.94	0.35
Purse-seine power block	172791_a **(2.55)**	271000_b **(2.26)**	4.16	0.00**
Total of mean of the fixed assets	**6777232** **(100.00)**	**11983406** **(100.00)**		
Average of total capital investments in fixed assets	**5848750_a**	**10224169_b**	**5.91**	**0.00****

Note: **Variables significant at 5%, * significant at 10%, subscript a, a, represents no significant difference and a, b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of fixed asset, **Source:** Researcher's compilation based on data analyis from primary survey.

size of the vessel, *t*(2,71)=-2.05, *p*=0.06<0.10, rejecting the null hypothesis at 10% level of significance. The cost of reconditioning is incurred only by 14 respondents since most of the vessels were not aged vessels. The cost incurred on reconditioning helps to increase the life of the vessel. However, when the life of the purse-seine vessel is considered, frequent repair and maintenance is a necessity for all the sizes of vessels.

The respondents use different types of purse-seine nets of different mesh size to capture different species of fish such as mackerels, sardines, kingfish, solar shrimps, tuna and others. The respondents claim that the price of all the purse-seine fishing gears on single vessel in 2016-17 would range approximately between ₹ 20,00,000 to 70,00,000 depending on the dimension of the purse-seine net, size of the vessel, mesh size, length, and weight of purse-seine net. There is a statistically significant relation between the variable cost of the purse-seine net against the size of the vessel *t* (2,71)=-2.42,*p*=<0.05), rejecting the null hypothesis. According to Hassan

& Sathiadhas (2009), the length of the fishing gear is directly proportional to the horsepower of the vessel. As the size of the vessel increases, the dimension of the gear to be used also increases to maximize efficiency. As per the result in table 7.10, in case of variable capital investment in fixed assets across the size of vessels, the null hypothesis is rejected. It could be concluded that there are statistically significant differences in the mean values for variables hull, engine, amount to modify vessel, cost of fishing gear, power block, among the medium and large size vessels. The reasons for these differences of investment in fixed assets depends on the size of the vessel, horsepower of the engine, type of fishing gears and other equipment used.

The statistical analysis of variable capital investment across the size of the vessels given in table 7.10 and across the jetties given in appendix Table 7A is summarized together in table 7.11. The results of independent sample *t*-tests across

Table 7.11 Summary of Statistical Significance of Average of Capital Investments in Fixed Assets by Fishermen Owning Purse-seine Vessels

Capital Investment in Fixed Assets	Size of Vessel	Jetties
Hull of vessel	Significant	Not Significant
Engine of vessel	Significant	Not Significant
Amount to modify the vessel	Significant	Not Significant
Reconditioning of vessel	Significant	Significant
Cost of fishing gear	Significant	Significant
Safety and other equipment	Not significant	Not significant
Purse-seine power block	Significant	Not significant
Average of total fixed assets	Significant	Significant

Note: Results of ANOVA tests for Jetties available in Appendix (Table No 7A) **Source:** Researcher's compilation from the data analysis based on primary survey.

the size of the vessels and ANOVA results across jetties, shows that there are statistically significant differences in the variables, cost of reconditioning, fishing gear and average of total capital investment in fixed assets, rejecting the null hypothesis.

Any discussion on investment in fixed assets will not be meaningful without considering the fixed costs. It is imperative to discuss fixed costs, as fixed costs are incurred by the purse-seine owners to arrive at net profit. This is discussed in section 7.3.5.4.

7.3.5.4 Fixed Costs incurred by Fishermen on Purse-seine Vessels

Fixed costs remain constant in total, regardless of changes in volume upto a certain level of output. They are not affected by the changes in the volume of production. They have to be incurred even when the output is nil (Maheshwari &

Varshney, 2014). The fixed costs incurred in fishing and computation of depreciation is provided in the Research Methodology chapter section 3.2. Table 7.12 gives the results of the Independent sample *t*-test conducted to find the mean differences of fixed costs among the sizes of the vessels. One way ANOVA test was conducted to find the mean differences of fixed costs among the jetties, the results of which are given in the Appendix table 7B. The null hypothesis proposed is that, *"There is no significant relation between fixed costs across the size of purse-seine vessels"*. The same hypothesis is checked across jetties and the results are given in Appendix table 7B, taking jetties as an independent variable. The dependent variable is fixed costs, and the independent variable is size of the vessel. In table 7.12, the Independent sample *t*-tests results show that the highest percentage of depreciation is on the

Table 7.12 Results of Independent Sample *t*-test of Fixed Costs incurred by Fishermen Owning Purse-seine Vessels

Variables (Fixed costs)	**Size of vessel category**		**Independent sample t-test**	
	Medium vessel	**Large vessel**		
	Mean (₹)	**Mean (₹)**	**t-value**	**Sig**
Depreciation on hull, engine and winch	424180_a **(39.35)**	603380_b **(43.17)**	-5.44	0.00**
Depreciation on amount to modify vessel	9880_a **(0.92)**	14169_b **(1.01)**	-5.77	0.00**
Depreciation reconditioning	10186_a **(0.94)**	14222_a **(1.02)**	0.78	0.43
Depreciation on fishing gear (Purse-seine net)	241047_a **(22.36)**	308519_b **(22.07)**	-2.42	0.01**
Depreciation on safety and other equipment	2351_a **(0.22)**	2723_a **(0.19)**	-0.94	0.35
Depreciation on purse-seine power block	17279_a **(1.60)**	27100_b **(1.94)**	-4.16	0.00**
Insurance on vessel and crew	88264_a **(8.19)**	118050_a **(8.45)**	-0.93	0.35
License fee, contribution towards society and maintenance of jetty	4752_a **(0.44)**	5143_a **(0.37)**	-0.91	0.36
<u>Finance costs</u> Interest paid on the loan	280000_a **(25.98)**	304500_a **(21.78)**	1.31	0.20
Total of mean of fixed costs	1077939 **(100.00)**	1397806 **(100.00)**		
Average of total fixed costs	**676666_a**	**1217473_b**	-5.68	0.00**

Note: ** Variable significant at 5% significance level, subscript "a, a, a" means no significant difference and "a,b,c" means there is a significant difference. Figures in (parenthesis) indicate percentages, **Source:** Researcher's compilation from the data analysis based on primary survey.

variable hull and engine followed by fishing gear for medium and large vessels, statistically significant, rejecting the null hypothesis. Depreciation on the amount to modify vessel and power block is also statistically significant at 5% level. The major portion of the fixed costs constitutes depreciation and in addition to depreciation, among other fixed costs, the respondents also incur a higher percentage on interest on loan of the total fixed costs. In Goa, the fishermen owning medium and large vessels have availed loans from banks, thus paying a higher amount of interest on the loan. This in line with the findings of Kamble et al. (2013) who find that depreciation on purse-seine craft was 31% and the interest on loan as 21% on purse-seine vessels on the coast of Maharashtra.

The Independent sample *t*-tests statistical analysis conducted on the variables under fixed costs against the size of the vessel in table 7.12 and ANOVA test across the jetties in appendix table 7B is shown in summary table 7.13. It is evident from the results in table 7.13 that in case of total average fixed costs against the size of the vessel there is a statistically significant difference, but across the jetties, there are no statistically significant differences. The statistical differences in fixed costs among jetties is observed in case of variable depreciation on reconditioning, purse-seine net, safety equipment, license fee and interest on loan due to the following reasons. Reconditioning of the vessels is done mostly by the respondents on Vasco jetty and on a few vessels on Malim and Cutbona jetties. Vasco and Malim jetties have limited space to accommodate vessels for landing and berthing purpose. This leads to collision among vessels resulting in high cost of repair and maintenance every year. The respondents have raised their concerns to the government but till date there is no satisfactory solution to this problem. The respondents on Malim and Cutbona jetties

Table 7.13 Summary of Statistical Significance of Average of Fixed Costs Across Size of Purse-seine Vessels and Jetties

Fixed costs	Size of vessel	Jetties
Depreciation on hull and engine	Significant	Not significant
Depreciation on modification of vessel	Significant	Not significant
Depreciation on reconditioning	Not significant	Significant
Depreciation on purse-seine net	Significant	Significant
Depreciation on safety and other equipment	Not significant	Significant
Depreciation on purse-seine block	Significant	Not Significant
Insurance on vessel and crew	Not Significant	Not Significant
License fee and contribution towards maintenance of jetty	Not Significant	Significant
Interests on loan	Not significant	Significant
Average of total fixed costs	Significant	Not Significant

Note: ANOVA Results for Jetty available in Appendix (Table No 7B), **Source:** Researcher’s compilation from the data analysis based on primary survey

invest a higher amount on purse-seine nets, as compared to the respondents on Vasco jetty. Hence, there are statistically significant differences in depreciation on nets. In case of safety and other equipment, the investment made by the respondents on vessels operating at Vasco and Cutbona jetties differ due to which depreciation on it also differs. The licence fee is paid by all the respondents across all the jetties. However, contribution for maintenance towards jetty is paid only by respondents of Cutbona jetty. Other jetties do not take contribution from the respondents towards the maintenance of jetty.

The next analysis in section 7.3.5.5 is on the variable costs (operating cost). Operating costs is taken as a variable to arrive at the gross profit from the purse-seine business.

7.3.5.5 Operating Costs Incurred on Purse-seine Vessels

According to R.Sathiadhas (1989) operational costs of fishing units includes the cost on repair, maintenance, fuel, wages, auction and other day-to-day expenses. The details of operating costs are given in the Research methodology chapter section 3.2. In the present study, for the variable operating costs across the size of vessel, the null hypothesis stated is that, *"There is no significant statistical relationship between operating costs across the size of purse-seine vessels"*. The same hypothesis is checked across jetties and the results are given in Appendix table 7C, taking jetties as an independent variable. Independent sample *t*-tests were conducted by taking operating costs as dependent variable and size of the vessel as the independent variable. Percentage wise distribution of items constituting variable cost in table 7.14 indicates that the maximum contribution of the operating cost was incurred on diesel. This is in line with the findings of Kamble et al. (2013) who states that cost of diesel alone was 40.20%. The results of independent sample *t*-tests shows that the highest percentage of the total of operating costs is incurred on fuel, followed by wages, cost of ice and food for labour which is statistically significant at 5% level. The results are in similar to the findings of Chilamba, (2016) who conclude that variable fuel consumption was the most significant cost and varied according to the size of vessel and type of gear. The cost of fuel is highest for the medium as well as large vessels. Medium vessels go for fishing on an average between 1-5 days consuming on an average 100-150 litres fuel per day. Large vessels travel a longer distance for multi-day fishing ranging from approximately 10-15 days duration per trip, consuming average fuel from 200-400 litres per day. The respondents stated that in Goa after mid-December to mid-April fish is not available in close vicinity and hence they spend more amount on fuel searching for fish catch. High fluctuations in the diesel prices also creates instability in the purse-seine operations as one fishing operation needs high investment in operating costs mostly for fuel, wages and ice.

Table 7.14 Results of Independent Sample *t* test of Operating Cost incurred by Fishermen Owning Purse-seine Vessels

Variables	Size of Vessel Category		Independent Sample t-test	
	Medium vessel	Large vessel	*t*-value	Sig
	Mean (₹)	Mean (₹)		
Fuel costs after diesel VAT subsidy	2312840_a	2963076_b	-3.26	0.00**
	(37.68)	**(38.20)**		
Wages to labour	2214483_a	2771706_b	-3.26	0.00**
	(36.08)	**(35.74)**		
Food , batta and (Ration)	393298_a	481773_b	-3.72	0.00**
	(6.41)	**(6.21)**		
Cost of Ice	522192_a	622131_b	-2.00	0.04**
	(8.51)	**(8.02)**		
Regular maintenance	185248_a	203413_a	-1.2	0.23
	(3.02)	**(2.62)**		
Mending of nets	227277_a	334148_b	-2.82	0.00**
	(3.70)	**(4.31)**		
Oil and Lubricants	70981_a	76391_a	-1.13	0.26
	(1.16)	**(0.98)**		
Marketing and transportation	203068_a	291166_b	-2.15	0.03**
	(3.31)	**(3.75)**		
Miscellaneous expenses	8394_a	12179_b	-2.67	0.00**
	(0.14)	**(0.16)**		
Total of mean of operating costs	6137781	7755983		
	(100.00)	**(100.00)**		
Average of total operating costs	**6104267_a**	**7745526_b**	**-3.67**	0.00**

Note: ** Variable significant at 5% significance level, subscript "a, a" means no significant difference and "a,b" means there is a significant difference. Figures in (parenthesis) indicate percentages **Source:** Researcher's compilation from the data analysis based on primary survey.

The next important factor of production is labour. Respondents owning purse-seine vessels employ more labour as compared to trawlers. Purse-seine gear is highly labour intensive with an average of 25 workers employed on medium vessels and 31 labourers on large vessels per trip (See table 7.5.). This finding corresponds with the results of the study by Aswathy et al., (2011) who finds that purse-seine vessels employ 30 workers per trip. The wages paid to these employees are of different nature. There is a system of percentage share of wages, where the respondents deduct the diesel fuel expenses, cost of ice per trip from the gross revenue earned from the fish catch per trip. Thereafter, on the remaining net revenue, the captain "*Tandel*", "*Aryamen*" and "*Mastman*" employed on the purse-seine vessel is paid on a percentage basis. "*Batta*" is a commission which is given on the fish catch. The percentage of "*Batta"* on the net revenue is 5% each for first tandel and first aryaman, followed by 3% each for second tandel and second aryaman, and 2% for mastman. The wages of the first "*Tandel"* and first "*Aryaman"* can range on an average approximately between ₹ 1,00,000 to ₹ 150,0000 p.m. depending on the season, fish catch and net revenue. The other crew will get fixed amount of average wage ranging between ₹ 8,000 to ₹ 10,000 per month, besides sea going incentives. Besides, "*Batta*", some respondents also give seagoing incentives to the first "*Tandel"* and first "Aryaman approximately between ₹ 900 to 1000, and the second "*Tandel"* and second "*Aryaman"* get an approximate of ₹ 400-500, and the rest of the labourers get ₹ 100-200 per trip, if there is bumper catch. The medium vessels carry on an average 5-10 tons of ice per trip and 61-75 feet carry 10-30 tons of ice per trip depending on the number of fishing days. In case of variables operating costs, namely fuel, wages, food, ice, mending of nets, marketing and miscellaneous expenses, there is statistically, significant relation at 5% level of significance across the size of the vessels rejecting the null hypothesis.

Table 7.15, gives the summary of the results of average of operating costs across the size of the vessels. The results of ANOVA test jetty-wise are given in appendix table 7C. Table 7.15 shows that total average of operating costs is statistically significant across the size of the vessel and the jetties. There are statistically significant differences for operating costs such as wages, cost of ice, mending of nets and marketing across the size of the vessels and the jetties. The differences are due to the following reasons. In case of wages paid to labourers, the number of labourers employed differs as per size of the vessels, across all the jetties.

Table 7.15 Summary of Statistical Significance of Operating Costs Across the Size of Purse-seine Vessels and Jetties

Variables	Size of vessel	Jetties
Fuel cost	Significant	Not Significant
Wages	Significant	Significant
Food, Batta, and Ration	Significant	Not Significant
Cost of Ice	Significant	Significant
Repair and Maintenance	Not Significant	Not Significant
Mending Nets	Significant	Significant
Oil and Lubricants	Not Significant	Not Significant
Marketing	Significant	Significant
Miscellaneous expenses	Significant	Not Significant
Total average of operating cost	Significant	Significant

Note: ANOVA Results for Jetties available in Appendix (Table No. 7C). **Source:** Researcher's compilation from the data analysis based on primary survey.

Hence, there is a statistically significant difference among all the three jetties. In case of cost of ice, the percentage of ice consumption was more on Cutbona jetty, as the respondents own larger vessels that have bigger fish holds to carry more ice on board, as compared to respondents from Malim and Vasco jetties. The cost of mending nets is more on Malim and Cutbona jetties, as these respondents own large size vessels requiring more investments on the fishing gears (nets). They also spend a substantial amount on mending of nets for every fishing season. Marketing and transportation costs are statistically significant as most of the respondents on Cutbona and Malim jetties own insulated trucks and incur expenses to market the fish outside the state. Thus, the overall results in table 7.15 show that the operating costs has a significant statistical relation as per the size of the vessel and the jetty, thus rejecting the null hypothesis.

The other factors which influence the net profit are fishing trips, fishing days and fishing hours of the purse-seine vessels discussed in section 7.3.5.6.which are important determinants of the gross revenue.

7.3.5.6 Other Factors Affecting Operations of Purse-seine Business

The operational factors affecting purse-seining is fishing days, trips, and hours. The null hypothesis proposed is that, "*Across the size of the purse-seine vessels there is no significant statistical relation between fishing trips, fishing days, fishing hours for entire fishing season from August to May*". The same hypothesis is checked across jetties and the results are given in Appendix Table 7D, taking jetties as an independent variable. Independent sample *t*-test results in table 7.16 shows the statistical relation between these variables. The dependent variables are fishing trips, fishing days and fishing hours and the independent variable is the size of the vessel. The data in table 7.16 shows that fishing days statistically significantly differ between

Table 7.16 Results of Independent Samples *t* test of Fishing Trips, Days and Hours of Purse-seine Fishing for Entire Season (August to May)

Variables	Size of vessel category		Independent Samples *t* test	
	Medium vessel	Large vessel		
	Mean	Mean	t-value	Sig
Total Fishing trips	46_a	40_a	0.76	0.44
Total Fishing days	215_a	224_b	-2.01	0.04**
Total Fishing hours	1018_a	1024_a	-0.09	0.92

Note: ** Variable significant at 5% significance level, subscript "a, a," means no significant difference and "a, b, "means there is a significant difference, **Source:** Researcher's compilation from the data analysis based on primary survey.

medium and large purse-seine vessels due to various reasons. The medium size vessels ranging from 46-55 feet will venture for purse-seine fishing on an average for single day or two days. The vessels above 55-60 feet will make on an average of two to five days trip and vessels above 60-75 feet venture on an average between eight to ten fishing days for purse-seine fishing during peak season between August to November as the fish is easily available in the closest vicinity. The respondents stated that since December to May the duration of fishing trip for 65ft to 75ft vessels for deep sea fishing varies between 10-15 days per trip. The medium and large vessels make maximum trips of less number of days between one to eight days during the most favourable post-monsoon season (August–November). During the months from December to May, vessels go into deep seas resulting in less number of trips and more number of fishing days. According to the respondents, the fish catch during the months from February to April is very less compared to other months.

Table 7.17 provides the summary of results of average trips, fishing days and fishing hours across the size of the vessels and the jetties. Jetty-wise results are given in Annexure table 7D. The size of the vessel as a variable has statistically significant relation to the number of fishing days. In case of jetties, there is a significant relationship with the number of trips and fishing hours. Fishing trips statistically significantly differ between Vasco and Cutbona jetties. Fishing hours statistically

Table 7.17 Statistical Significance of Fishing Trips, Days and Hours Across Size of Purse-seine Vessels and Jetties

Variables	Size of vessel	Jetties
Total fishing trips	Not Significant	Significant
Total fishing days	Significant	Not Significant
Total fishing hours	Not Significant	Significant

Note: ANOVA results for jetties available in Appendix (Table No.7D) **Source:** Researcher's compilation from the data analysis based on primary survey.

significantly differ across Malim and Cutbona jetties and Vasco and Cutbona jetties, as respondents at Cutbona jetty take vessels for extensive fishing making the highest number of fishing hours followed by Malim jetty. The overall results conclude that across the jetties there is statistical significant difference for the variables fishing trips and fishing hours rejecting the null hypothesis. However, across the size of the vessels, there is statistical significant difference for fishing days, rejecting the null hypothesis.

The next section 7.3.5.7 shows the analysis of costs and profits of purse-seine fishing business as it is important to understand the viability of purse-seine business.

7.3.5.7 Analysis of Costs, Earnings and Profit of Purse-seine Fishing Business

The economic performance of purse-seine vessels in fishery industry depends on costs they incur and the earnings made by them. Hence, an analysis of costs, earnings and profits would give a clear picture of the purse-seining business in Goa. The formulae for computation of gross revenue, gross profit and net profit are given in Research Methodology chapter in section 3.2 equations 3.1, 3.2 and 3.3. The Independent sample *t* test were conducted to find the statistical relationship between the size of the vessels and one way ANOVA test is conducted across the jetties towards the economic indicators i.e costs, earnings and profits of purse-seine business. The null hypothesis proposed is that, "*Across size of the vessels there is no significant difference between costs, catch, earnings and profits per trip from purse-seine vessels".* The same hypothesis is checked across jetties and the results are given in Appendix table 7E, taking jetties as an independent variable. The dependent variables are costs, catch, earnings and profit and independent variables are size of the vessels and the jetties. The Independent sample-*t* test results in table 7.18 indicates that operating costs, fixed costs, total costs, and earnings per trip are statistically

Table 7.18 Analysis of Costs, Earnings and Profits Across the Size of the of Purse-seine Vessels for Entire Season (August-May)

Variables	Size of vessel category		Independent Samples *t* test	
	Medium vessel	Large vessel		
	Mean (₹)	Mean (₹)	*t*	Sig
Total operating costs per trip **(₹)**	146195_a	191141_b	-3.50	0.001**
Total fixed costs per trip **(₹)**	17024_a	31074_b	-4.50	0.00**
Total costs per trip **(₹)**	163219_a	222215_b	-3.89	0.001**
Total catch for entire season **(in kgs)**	89300_a	108553_a	-1.49	0.13
Catch per trip **(in kgs)**	2147_a	2681_a	-1.64	0.10
Earnings/Gross Revenue per trip **(₹)**	199104_a	258993_b	-3.04	0.003**
Gross profit per trip **(₹)**	52909_a	67852_a	-1.91	0.05*
Net profit per trip **(₹)**	35887_a	36778_a	-0.12	0.89

Note: ** Variable significant at 5% and * variable significant at 10% significance level, subscript" a, a" means no significant difference and "a, b" means there is a significant difference. **Source:** Researcher's compilation from the data analysis based on primary survey.

significant across the size of the vessels at 5% and gross profit per trip at 10% level of significance rejecting the null hypothesis. The average operating costs to the total costs per trip for medium vessels is 89 %, and the average fixed cost to the total costs per trip is 10 %. In case of large vessels, the operating cost per trip is 86 %, and an average fixed cost to the total costs per trip is 14%. The costs and earnings increased with multi-day operations. In the study area it is observed that in the long run the business of the large sized vessels is self-sustainable, as they get more fish catch and also earn more gross revenue, gross and net profit per trip compared to the medium vessels.

Table 7.19 provides the summary of key economic indicators across the size of the vessels and the jetties. Table 7.19 shows that the variables total operating costs, total costs and earnings per trip is statistically significant at 5% level of significance across the size of vessels and the jetties. The results of one way ANOVA given in Appendix table E, shows that across jetties, the variables operating costs per trip, total costs per trip, total catch (kgs), catch per trip, earning, gross profit and net per trip are statistically significant at 5% significance level, rejecting the null hypothesis. The

Table 7.19 Summary of Statistical Significance of Average Costs, Earnings and Profit Across the Size of Purse-seine Vessels and Jetties for Entire Season (August-May)

Variables	Size of vessel	Jetties
Total Operating cost per trip **(₹)**	Significant	Significant
Total fixed cost per trip **(₹)**	Significant	Not Significant
Total cost per trip **(₹)**	Significant	Significant
Total catch **(in kgs)**	Not Significant	Significant
Catch per trip **(in kgs)**	Not Significant	Significant
Earnings/Revenue per trip **(₹)**	Significant	Significant
Gross profit per trip **(₹)**	Not Significant	Significant
Net profit per trip **(₹)**	Not Significant	Significant

Note: ANOVA Results for Jetties available in Appendix (Table No 7E), **Source:** Researcher's compilation from the data analysis based on primary survey.

performance of vessels on Cutbona jetty in terms of earnings, gross and net profit per trip is highest followed by Malim and Vasco jetties as seen in Appendix table E. Thus, from table 7.19 summary results it is concluded that there are statistically significant differences across the size of the vessels and the jetties for operating costs, total costs and earnings per trip at 5% significance level, rejecting the null hypothesis.

In the next section 7.3.6, an attempt is made to study the impact of socio-economic characteristics and geographic location (by districts) of fishermen on the net profit, earnings and savings from purse-seine fishing business.

7.3.6 Regression Analysis

This section analyses the impact of socio-economic characteristics, and geographic location (by districts) of the purse-seine vessel owners on the net profit, earnings from fish catch and the savings from mechanized purse-seine vessels for the entire fishing season August to May. The dependent variables are net profit, earnings from the fish catch and the savings from fishing business. The independent variables are socio-economic characteristics and the districts. A multiple linear regression model is estimated to examine the impact of the above mentioned factors on the three dependent variables, using three different equations. The explanatory independent and dependent variables chosen for the regression model are defined in the Research Methodology chapter section 3.6.

7.3.6.1 Impact of Socio-economic Characteristics on the Net profit, Earnings and Savings

The independent variables are X_{1}= Gender of the respondents, Dummy variable Male=1 and 0 for female respondents. X_{2} = Caste of the respondents, Dummy variable 1=OBC and 0 for general category, X_{3}=Educational qualification of the respondents (in years), X_{4}= Size of family (number of family members), X_{5}= Experience in fishing business (in years), X_{6} = Number of family members involved in fishing (number). There were no respondents below poverty line owning purse-seine vessels. Hence, financial status on the poverty line index is not considered in the study. So, It is hypothesized that, *"Socio-economic characteristics of the fishermen owning purse-seine vessels have an impact on the net profits, earnings from fish catch and the savings from purse-seine fishing business."* While testing the multiple linear regression models, the null hypothesis proposed is that, *"Socio-economic characteristics of the fishermen owning purse-seine vessels have no impact on the net profits, earnings from fish catch and savings from purse-seine fishing business."* The three multiple regression equations specified are mentioned in Research Methodology chapter in section 3.8.7.3. in equation numbers 3.17, 3.18 and 3.19. The multiple regression model is estimated on the data collected from 73 respondents. The tests show that age and number of years of experience in fishing business had issues of multi-collinearity. Hence, age as a variable has been dropped from the variables for this model. Instead, the variable number of years of experience in fishing business is used as proxy for age.

7.3.6.1.a Impact of Socio-economic Characteristics on the Net profit

In the multiple regression model given in table 7.20 assumptions of linearity and homoscedasticity were verified by the scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multicollinearity was also observed using VIF values which were less than 5 concluding that the assumptions of multicollinearity were met.

Table 7.20 Impact of Socio-Economic Characteristics of Fishermen on the Net profit, Earnings and Savings from Purse-seine Vessels

Socio-economic variables	Equation 1 (7.1)			Equation 2(7.2)			Equation 3 (7.3)		
	Net Profits (Y_1)			Earnings from Catch (Y_2)			Savings from fishing business (Y_3)		
	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value	Unstandardized Coefficient (Beta)	*t*-value	*p*-value
(Constant)	-955468	-0.76	0.45	530699	0.18	0.85	-348549	-0.69	0.48
X_1 *Gender Is Male*	1149218	2.05	0.04**	4482296	3.45	0.001**	448564	2.01	0.04**
X_2 Caste *Is* (OBC)	870195	2.64	0.01**	2729754	3.57	0.001 **	314275	2.40	0.01**
X_3 *Qualification (Yrs)*	32901	0.61	0.54	97607	0.78	0.43	5866	0.27	0.78
X_4*Size of family members (No.)*	-2008	-0.01	0.98	48719	0.14	0.88	16296	0.28	0.77
X_5 *Experience in fishing business (Yrs)*	5392	0.39	0.69	13519	0.43	0.67	1210	0.22	0.82
X_6 *Family members involved in fishing business (No.)*	244797	0.73	0.46	462111	0.59	0.55	103031	0.77	0.44
Adjusted R^2	50.30%			60%			40%		
F- and *p* value	2.39	*p* =0.03		*F*-value = 5.02	*p*= 0.00		*F*-value = 2.18	*p*= 0.049	

Note: Variable significant at **5%, **Source**: Researcher's compilation from the data analysis based on primary survey.

The multiple regression model given in table 7.20 as equation 1(7.1) explains the following results. The model predicts the dependent variable and the coefficient of determination, Adjusted R^2 indicates 50.30% variation in net profit is explained only by the socio-economic variables, whereas, 49.70% variation is determined by other factors not considered. Gender, caste, educational qualification, size of the family members, experience in fishing business and number of family members involved in fishing could statistically predict the net profit, $F(6,66)=2.39$, $p< 0.03$. It is observed that there is a positive slope coefficient for gender, caste, educational qualification, experience in fishing business and the family members involved in fishing. The variables that are statistically significant at 5% significance level, are gender ($p = 0.04$), and caste is OBC ($p=0.01$). The results in equation 1(7.1) shows a positive relationship between gender and net profits, caste and net profit and it is in line with the expected results. Gender i.e male respondents are showing significant difference as out of 73 respondents five are female respondents, male respondents have more experience in handling the mechanized purse-seine fishing business as compared to female respondents and this factor helps the male respondents to earn higher profits as compared to female respondents. If a male respondent is directly involved in fishing business compared to a female respondent, net profit of male respondent on an average would increase by ₹ 11,49,218, keeping other variables constant, statistically significant at 5% level. Hence, the null hypothesis is rejected. Female respondents have purse-seine vessels registered in their names, but seldom get directly involved in fishing business, causing less profit earned by them.

In the case of caste, the OBC category respondents are traditional fishermen whose ancestors have been doing the fishing business for generations continued by them over the years. They are aware of the fishing skills, the technology required, the type of fishing gears used to catch different species of fish and can easily identify the fishing grounds. The fishermen belonging to general category are new entrants in purse-seine fishing business, and were mostly found on Malim and Cutbona jetties. Thus, if a fishermen belonging to OBC category is involved in purse-seine fishing business, as compared to fishermen from general category, the net profit on an average of OBC fishermen would increase by ₹ 870196, keeping other variables constant, statistically significant at 5% level. Hence, the null hypothesis is rejected. As expected the results show that a positive relation exists between the variables educational qualification and net profit, experience in fishing business and net profit, the family members involved in fishing and net profit but not statistically significant at 5% level, failing to reject the null hypothesis. The negative slope coefficients were observed for the variable size of the family and are in line with the results obtained but were not statistically significant at 5% level, failing to reject the null hypothesis. Thus, overall among all other variables, only two explanatory variables viz. gender and OBC caste category have statistically significant impact on net profit of purse-seine fishing business.

7.3.6.1.b Impact of Socio- economic Characteristics on the Earnings from Fish Catch

The analyses of the impact of socio-economic characteristics on the earnings from fish catch are given in table 7.20, equation 2 (7.2). The Adjusted R^2 for the overall model in table 7.20, for equation 2(7.2) indicates 60% of the variation in the earnings from fish catch is explained by socio-economic factors namely gender, caste, qualification, the size of family members, experience in fishing business and the number of family members involved in fishing. These factors could statistically predict the earnings from catch, $F(6,66) = 5.02$, $p<0.05$. The F-value being significant is also an indication that the model has a good fit to justify the factors influencing the fishing business in the study area. However, 40% of the variation in the earnings is determined by other factors not considered in the model. The variables that are statistically significant at 5% significance level, are gender, male (p=0.001), and caste, OBC (p=0.001). The results in equation 2(7.2) in the model showed that a positive relationship exists between the variables namely gender and earnings, caste and earnings and it is in line with the results. The variable gender is significant as male respondents earn higher earnings from fish catch as compared to female respondents. If a male respondent is involved in fishing business compared to a female respondent, earnings from fish catch would increase on an average by ₹ 44,82,296 keeping other variables constant, statistically significant at 5% level. Hence, the null hypothesis is rejected. In case of fishermen belonging to OBC category involved in purse-seine fishing business, as compared to the fishermen from the general category, the earnings on an average of OBC fishermen would increase by ₹ 27,29,755 keeping other variables constant, statistically significant at 5% level. Hence, the null hypothesis is rejected.

As expected a positive relation exists between the variables educational qualification and earnings, experience in fishing business and earnings, family members involved in fishing and earnings but not statistically significant at 5% level, failing to reject the null hypothesis. The relationship between the variables the size of the family and earnings was expected to be negative; however, a positive slope coefficient is observed which is not in line with the expected results, although not statistically significant at 5% level, failing to reject the null hypothesis. The results of equation 2(7.2) model showed that out of all the six socio-economic independent variables considered, two variables namely; gender i.e male and OBC caste respondents are the most important variables significantly influencing earnings of the fishermen. Thus, the overall results indicate that if an additional male belonging to OBC category enters into purse-seine fishing business, there would be statistically significant impact on the earnings from purse-seine fishing business.

7.3.6.1.c Impact of Socio-economic Characteristics on the Savings

The multiple regression model given in table 7.20 in equation 3(7.3) explains the impact of socio economic factors on savings from fishing business. The model predicts the dependent variable and returns an Adjusted R^2 of 40% for the overall model. The variables gender, caste, qualification, size of the family members, experience in fishing business and the number of family members involved could statistically predict the savings, $F(6,66)= 2.18$, $p=<0.05$ at 5% level of significance. There is a positive slope coefficient observed for gender, caste, qualification, experience in fishing business, and the number of family members and is in line with the expected results. However, the variables that are statistically significant at 5% level of significance are gender i.e male (p=0.04) and OBC caste (p=0.01). Thus, in line with this result, if a male is involved in fishing business compared to the female respondents, than the savings of the male respondents on an average would increase by ₹ 4,48,564 keeping all other variables as constant. In this case, the null hypothesis is rejected. In case of fishermen who belong to OBC category are involved in fishing business, as compared to the fishermen from general category, the savings on an average of the OBC fishermen would increase by ₹ 3,14,275 keeping other variables constant, statistically significant at 5% level, rejecting the null hypothesis. Although, the variables educational qualification, experience and number of family members involved in fishing have the expected signs and is in line with the hypothesis, but are not statistically significant at 5% level, hence, failing to reject the null hypothesis. In case of the variable size of the family members, a positive slope coefficient is observed and is contrary to the hypothesis, although not statistically significant at 5%

level, failing to reject the null hypothesis. Thus, the two independent variables, gender i.e male and OBC caste have statistically significant impact on the savings of the fishermen.

The overall summary of the socio-economic characteristics on the dependent variables shows that out of six variables considered in the study, the two explanatory independent variables namely gender i.e male and OBC caste respondents have a statistically significant impact on the three dependent variables.

In the next section 7.3.6.2 the impact of geographic location on the net profit, earnings and savings is discussed by using simple linear regression model.

7.3.6.2 Impacts of Geographic Location (by district) on the Net profit, Earnings and Savings

Alfred Weber's (1909) theory which emphasizes the geographical location of an economic activity is used for this simple linear regression model. The simple linear regression model is used to study the impact of geographic location (by districts) on the net profit, earnings from catch and savings of fishermen. In the present study, it is hypothesized that, "*Geographic location (by district) of purse-seine owners has an impact on the net profit, catch and savings of purse-seine fishing business".* The null hypothesis stated is that, *"There is no impact of geographic location (by districts) of purse-seine owners on the net profit, catch and savings of purse-seine fishing business".*

In the multiple regression model, $\boldsymbol{Y_4}$ is the dependent variable and denotes net profit, $\boldsymbol{Y_5}$ is dependent variable denotes earnings from catch and $\boldsymbol{Y_6}$ is the dependent variable denotes savings from fishing business. The independent variable is X_1 is district (Dummy variable South Goa=1 and North Goa=0), u_i is the residual error term assumed to have a zero mean and constant variance. There were 73 responses for this linear regression model. The dependent and independent variables are defined in Research methodology chapter, section 3.6. The three linear regression equations and the expectations are mentioned in Research Methodology chapter section 3.8.7.3 and equations 3.13, 3.14 and 3.15. Table 7.21 presents the results of the linear regression model, showing the impact of districts on net profits, earnings and savings. The assumptions of linearity and homoscedasticity were verified by the scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multicollinearity is also observed using VIF values which were less than 5 concluding that the assumptions of multicollinearity is met.

Table 7.21 Impact of Location viz. District on Net Profit, Earnings from Catch, and Savings of Fishermen Owning Purse-seine Vessels

District	Equation 4(7.4)			Equation 5(7.5)			Equation 6 (7.6)		
	Net Profits (Y_7)			Earnings from Catch (Y_8)			Savings from fishing business (Y_9)		
	Unstandardized Coefficient	t-value	p-value	Unstandardized Coefficient	t-value	p-value	Unstandardized Coefficient	t-value	p-value
Constant	846687	2.98	0.004	7833505	10.55	0.00	347059	3.08	0.003
X_1 **South Goa**	954581	2.94	0.004**	1613219	1.90	0.06*	358218	2.78	0.007**
R^2	11%			5%			10%		
***F*-value**	8.69	*p*=0.004		*F*-value =3.62	*p*= 0.06		*F*-value=7.77	*p*= 0.007	

Note: Variable significant at *10% and **5% significance level, Constant is North Goa as reference category,
Source: Researchers compilation from the data analysis based on primary survey.

7.3.6.2. a Impact of District on Net Profit

The model given in table 7.21 in equation 4(7.4) predicts the net profit (dependent variable) and R^2 explains 11% variation in net profit explained only by the districts, whereas, 89% variation is determined by other factors not considered in the study. The variable district South Goa could statistically predict net profit, $F(1, 71)=8.69$, $p<0.05$. The positive slope coefficient is observed for variable, district South Goa and is in line with the hypothesis. The variable district South Goa has statistically significant impact on the net profit at 5% level of significance, ($p=0.004$), rejecting the null hypothesis. These results indicates that if a respondent owning purse-seine vessel is from South Goa as compared to a respondent from North Goa than the net profit of the respondent from South Goa would increase on an average by ₹ 9,54,581 as compared to a respondent from North Goa. The probable reason is Cutbona jetty has better infrastructure facilities, more space that can accommodate all sizes of vessels, compared to Malim and Vasco jetties. The cost of repair and maintenance is also less on Cutbona jetty as compared to other jetties as there is no collision among the vessels due to larger space. Thus, all these factors have helped the respondents from Cutbona jetty with large size purse-seine vessels to earn higher net profits from purse-seine fishing business, as compared to the respondents from Vasco and Malim jetties.

7.3.6.2.b Impact of District on Earnings

On analysis of the model in table 7.21, using the equation 5(7.5) it can be seen that the variable South Goa predicts the dependent variable earnings and the R^2 indicates 5% variation in earnings, whereas, 95% variation is determined by other factors not considered in this model. The district South Goa could statistically predict earnings, F (1,76)=3.62, p=0.06<0.10, at 10% significance level. The positive slope is observed for variable district, South Goa and is in line with the hypothesis. The variable that is statistically significant at 10% level of significance is South Goa district, (p=0.06). In this case, the null hypothesis is rejected. The results show that if a respondent involved in purse-seine business is from South Goa as compared to a respondent from North Goa then the earnings of the respondent belonging to South Goa would increase on an average by ₹ 16, 13,219. Thus, the results indicate that the district of South Goa has statistically significant impact on the earnings of fishermen.

7.3.6.2.c Impact of District on Savings

The model given in table 7.21, using the equation 6(7.6) shows that the variable i.e District, South Goa predicts the dependent variable savings and the R^2 indicates 10% variation in savings, whereas, 90% variation is determined by other factors not considered in this study. The variable district i.e South Goa could statistically predict savings from fishing business, F(1,76)=7.77, p=<0.05. The positive slope is observed for district South Goa and is in line with the expected results. The variable district South Goa is statistically significant at 5% level of significance, (p=0.007), hence failing to reject the null hypothesis. The results indicate that the savings of a respondent in South Goa involved in purse-seine fishing business would increase on an average by ₹ 3,58,218 as compared to a respondent in North Goa. The results show that the district of South Goa has significant impact on the savings of the fishermen. The overall results reveal that the variable district, South Goa is found to have statistically significant impact on the net profit, earnings and savings from fishing business, rejecting the null hypothesis.

The next discussion given in section 7.3.7 explains the factors of production which are important to determine the output from fish catch in terms of earnings.

7.3.7 Factors of Production Influencing the Earnings of Purse-seine Owners Based on Cobb Douglas Production Model

A Cobb Douglas production function using multiple linear regression model is used in the study to examine the relationship between the input of factors of production and the output of fish catch viz. the gross earnings. The selected independent variables and the dependent variable used for the multiple regression model using Cobb Douglas theory are defined in the Research Methodology chapter section 3.6 and the Cobb Douglas model in section 3.8.7.5. and the equation is defined in 3.21. Based on the Cobb Douglas theory, it is hypothesized that "*There is an impact of selected input of factors of production on the earnings from output of fish catch".* The null hypothesis proposed is that, "*The selected input of factors of production has no impact on the earnings from the output of fish catch."* As per table 7.22, the log-log model form of regression is used to fulfill the conditions of

Table 7.22 Impact of Selected Input of Factors of Production on the Earnings of Fish Catch from Purse-seine vessels using Cobb Douglas Theory

Variables	Equation 7 (7.7) Log of earnings from fish catch			
	Unstandardized Coefficient (Beta)	Beta x100	*t*-value	*p*-value
(Constant)	0.40	40	0.58	0.56
X_1 ln experience in fishing business	0.03	3.0	1.38	0.17
X_2 ln horse power	0.04	4.0	0.74	0.46
X_3 ln total cost of fishing gear	-0.002	-0.2	-0.05	0.95
X_4 ln total wages	0.47	47	7.00	0.00**
X_5 ln fishing hours	0.49	49	6.60	0.00**
X_6 ln fishing trips	-0.13	-13	-2.64	0.01**
X_7 ln fuel cost after VAT subsidy	0.37	37	5.73	0.00**
Adjusted R^2	0.79	F value=82, p= 0.00		

Note: Variable significant at **5% , ln=log, **Source**: Researchers compilation from the data analysis based on primary survey.

normality. Log is taken of all the dependent and independent variables to keep uniformity. The production function is specified as log of earnings from the output of fish catch as the dependent variable and seven selected independent variables namely;

log of experience in fishing, log of horsepower of trawler, log of total cost of fishing gear, log of total wages paid to labour, log of fishing hours, log of fishing trips, and log of fuel cost after reimbursement of diesel VAT subsidy. There were 73 responses considered for this multiple regression model. The assumptions of linearity and homoscedasticity were verified by the scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multicollinearity is also observed using VIF values which were less than 5 concluding that the assumptions of multicollinearity are met.

The results of multiple regression model is given in the table 7.22. By using the equation 7 (7.7), the model, F (7,65) =82p=<0.05, is found to be statistically significant one, at 5% significance level. The coefficient of multiple determination, Adjusted R^2 for the overall model was 0.80, suggests that all the selected seven independent variables included in the function jointly explain 80% variation in the dependent variable log of earnings, whereas only 20% variation is due to other factors not considered in the model. It is observed that there are positive slope coefficients for variables log of experience in fishing, log of horsepower of vessel, log of wages paid to labour, log of fishing hours, log of fuel cost after reimbursement of diesel VAT subsidy. In the present investigation, among the seven selected independent variables, the variables that are statistically significant at 5% significance level, are log of wages paid to labour (p=0.00), log of fishing hours (p=0.00), log of fishing trips (p=0.01) and fuel cost (p=0.00).

It was expected to observe a positive relationship between all the seven independent variables and dependent variable, however, the results in equation 7(7.7) showed a negative coefficient for two variables, log of fishing gear and log of fishing trips, which were not statistically significant. This implies that for 1% increase in the log of cost of fishing gear, there is 3.0% decrease in the log of earnings on an average, not statistically significant, (p=0.95>0.05) and hence failed to reject the null hypothesis. In the case of variables log of fishing trips and log of earnings there is negative relation but statistically significant. It means that for 1% increase in the log of fishing trips, there is 13% decrease on an average in the log of earnings, which is statistically significant, (p=0.01<0.05), rejecting the null hypothesis. Thus, by only increasing number of fishing trips without getting the sufficient catch, it will result in increased operational costs affecting the earnings negatively. This implies that fishing trips will increase the earnings provided they get sufficient catch for every trip. In case of variables, log of experience and log of horsepower, there is a positive relation as expected but their impact on log of earnings is not statistically significant at 5% level. The values for log of experience, (p=0.17>0.05), and log of horsepower, (p=0.46>0.05), were more than 0.05, hence, failing to reject the null hypothesis. A positive relation is expected between variables, log of wages and log of earnings, and it is in line with the expected results, statistically significant at 5% level, (p< 0.05), rejecting the null hypothesis. This results show that by employing experienced and skilled labour and increasing their wages by one percent, it would result in 47% increase in the log of earnings on an average. As expected there is a positive relationship between log of fishing hours and log of earnings, and it is in line with hypothesis, statistically significant at 5% level, (p< 0.05). This implies that one percent increase in the number of productive fishing hours will result in 49% increase in the average earnings, keeping all other variables as constant, thus rejecting the null hypothesis. Therefore, as per respondents views, productive fishing hours during the peak season between August to November has helped them to get more fish catch resulting in more earnings.

It was expected to have a positive relation between the variables, log of fuel cost and log of earnings, and the results are in line with the hypothesis, statistically significant at 5% level, (p<0.05), rejecting the null hypothesis. This implies that one percent increase incurred on the fuel expenditure by the respondents on the purse-seine vessels will result in an increase in the earnings by 37% on an average, keeping all other variables constant. Fuel cost is a necessity and hence investing on fuel helps the respondents to take their vessels for deep sea fishing, in order to get more catch resulting in more earnings. The results using the multiple regression model shows that the three variables namely; wages paid to labour, fishing hours, fuel costs has a statistical significant positive functional relationship on the log of earnings from fish catch. In this model, it is found that all independent variables jointly determine the dependent variable and the model is statistically significant. Though the other variables namely experience in fishing, horsepower of vessel, fishing gear, has positive relation on the output of fish catch, their impact on log of earnings from production is not significant. The literature review has shown that other independent variables considered in this model although not found statistically significant but has impact on earnings. Thus, the multiple regression model using Cobb Douglas theory is found to be statistically significant at 5% level. The production function analysis using Cobb-Douglas theory indicated that there was ample scope for the respondents to enhance their earnings from fishing business, by increasing the input variables such as number of productive fishing hours, employing skilled and experienced labourers, enhancing fuel utilization and incurring expenditure on fuel. The results are in line with Najmudeen & Sathiadhas, (2007) who used the Cobb-Douglas model and found that fishing days and increasing the cost on fuel would help fishermen to earn more profits on mechanized vessels.

The next discussion on ratio analysis in section 7.3.8 is important to determine the economic efficiency indicators of the purse-seine vessels which are important to understand the economic and financial performance of the purse-seine vessels.

7.3.8 Ratio Analysis of Economic Indicators of Purse-seine Vessels

The study estimates the key economic indicators of the purse-seine fishing business on the basis of cost and earnings data. The formulae's used for different ratios are defined in Research Methodology chapter, section 3.8.7.6, equation number 3.22 to 3.40. Table 7.23, gives the analysis of the economic indicators used to measure the economic and financial performance of efficiency of purse-seine vessels with respect to the size of vessels in Goa in terms of ratios. The non-parametric Mann-Whitney U test is used for the different ratios since the ratios did not follow the test of normality. The dependent variables are the different ratios and the independent variable is the size of the vessels. The hypothesis stated is that, *"There is a significant difference between the economic and financial indicators in terms of ratios among the different size of purse-seine vessels in Goa".* The null hypothesis proposed is that *"There is no significant difference between the economic and financial indicators in terms of ratios among the different size of vessels in Goa".* The Mann-Whitney U test is based on mean rank and averages are used to compare all the economic indicators using ratios of different size of vessels. The results of relationships of the different ratios are summarized in table 7.23, as follows:

1. *Input – Output Efficiency* (*Cost ratios*)

i. *Operating ratio*: The input-output efficiency shows that the major portion of costs is incurred for operating expenses by the purse-seine owners. The operating ratios were not statistically significantly different across the size of the vessels, U=542,z =(-0.46), p=0.64>0.05, failing to reject the null hypothesis at 5% level of significance. Almost 75% of the gross revenue was spent towards meeting operating expenses by owners of medium and large size vessels.

Table 7.23 Results of Mann Whitney *U* test of Ratio Analysis of Economic Indicators of Efficiency with respect to the Size of Purse-seine Vessels

Sl. No	Economic parameters	Size of vessel categories		Mann Whitney *U* test		Decision
		Medium Vessel	Large Vessel			
		Average	Average	z	Asymp. Sig.	
1	**Input –output efficiency (Cost Ratios)**					
I	Operating cost ratio/Capital productivity (%)	74.74	75.39	-0.46	0.64	Fail to reject H_0
Ii	Fixed cost ratio (%)	8.52	12.22	-3.37	0.00**	Reject H_0
iii	Gross/Total cost ratio (%)	83.26	87.61	-1.76	0.07**	Reject H_0
2	**Capital efficiency**					
I	Capital turnover ratio	1.45	1.11	-2.96	0.00**	Reject H_0
Ii	Payback period (years)	3.57	5.67	-2.35	0.01**	Reject H_0
iii	Rate of Return on investment(capital)(%)	15.71	26.61	-2.66	0.008**	Reject H_0
3	**Profitability ratios**					
I	Benefit Cost Ratio (BCR)	1.16	1.21	-1.76	0.07*	Reject H_0
Ii	Gross profit /Net operating income ratio(%)	25.26	24.61	-0.46	0.64	Fail to reject H_0
iii	Net profit ratio(%)	16.74	12.39	-1.76	0.07*	Reject H_0
4	**Efficiency ratios**					
I	Catch per trip (kgs)	2146	2681	-1.55	0.12	Fail to reject H_0
Ii	Labour Productivity/ Catch per labour (kgs)	3309	3364	-0.10	0.91	Fail to reject H_0
iii	Labour Productivity (Rs)(Gross revenue per labour man days)	316782	332518	-0.47	0.63	Fail to reject H_0
Iv	Capital per labour **(`)**	227866	328915	-4.33	0.00**	Reject H_0
5	**Cost volume profit analysis (Marginal efficiency)**					
I	Break Even Point (%)	36.70	56.66	-2.61	0.009**	Reject H_0
Ii	Profit Volume ratio (%)	25.26	24.61	-0.46	0.64	Fail to reject H_0
iii	Ratio of MOS (%)	27.00	43.00	-2.64	0.008**	Reject H_0

Note: Variable significant at **5%, and *10%, Mann Whitney U test based on mean rank, Averages are used for comparison, **Source**: Researchers compilation from the data analysis based on primary survey.

ii. *Fixed cost ratio*: The fixed cost ratios were statistically significantly different against the size of the vessels, U=300, z= (-3.47), p=0.00<0.05, and hence, rejects the null hypothesis at 5% level of significance. A substantial amount in the form of interest on loan as well as insurance on the vessel is spent on the fixed costs by the fishermen resulting in higher fixed cost ratio.

iii. *Total cost ratio*: The total cost ratios was statistically significantly different against the size of the vessels, U=434, z=(-1.76), p=0.07<0.10, rejecting the null hypothesis at 10% level of significance. The total cost percentage varies from 83% to 87%. The respondents owning large vessels incur higher operating costs and fixed costs as compared to the medium vessels.

2. *Capital efficiency*

i. *Capital turnover ratio*: There is a statistically significant difference between the capital turnover ratios against the size of the vessels, U=335, z= (-2.96), p=0.00<0.05, rejecting the null hypothesis at 5% level of significance. The capital investment made by fishermen owning medium sized vessels is less as compared to large vessels. This helps the fishermen owning medium sized vessels to recover their capital investment from gross revenue faster than large sized vessels.

ii. *Payback period* (*in years*): There is statistically significant difference for the variable payback period against the size of the vessels, U=385,z=(-2.35), p=0.01<0.05, rejecting the null hypothesis at 5% level of significance. Medium vessels are found to be more efficient in terms of payback period, because it takes less time, 3.57 years for respondents to recover their capital investment, whereas large vessels have taken more time, 5.67 years to recover the capital investment. The main reason being the higher cost of capital investments in fixed assets, made by the owners of large vessels. However, increasing the size of the vessels would help them to venture into deep sea fishing enabling them to get better fish catch, would give them better gross revenue, which will help them to recover the operational and fixed costs of the vessels. These factors will positively help the purse-seine owners in Goa to recover their capital investment in less than six years.

iii. *Return on Investment*: There were statistically significant differences for the variable return on investment against the size of the vessels, U=359,z=(-2.66), p=0.008<0.05, rejecting the null hypothesis at 5% level of significance. It is evident from the present study that for every ₹ 100 invested by respondents, there will be a return of 26.61% for medium vessels and 15.71% for large vessels. The financial analysis shows that medium vessels which go for fishing on an average for 1-5 days performed better than large vessels which go fishing for 8-15 days with higher return on investment of 26.61% than large size vessels with 15.71%. These findings are quite close to the study by Sushil Kamble et al., (2013) whose findings show that net profit ratio was 37% of purse-seine vessels in Ratnagiri.

3. *Profitability ratios*

i. *Benefit Cost Ratio* (BCR): There were statistically significant difference between benefit cost ratio against the size of the vessels, U=434, z=(-1.76), p=0.07<0.10, and hence, the null hypothesis is rejected at 10% level of significance. In the present analysis, fishing is profitable and feasible for the respondents, since the BCR recorded a value of more than one for all the sizes of the vessels. Medium as well as large size vessels are financially viable.

ii. *Gross profit ratio*: The gross profit ratios were not statistically significantly different across the size of the vessels, U=542,z=(-0.46), p=0.64>0.05, and hence failing to reject the null hypothesis at 5% level of significance. There is not much of variation between gross profit among the medium and large sized vessels.

iii. *Net profit ratio*: The net profit ratio is statistically significantly different against the size of the vessels, U=434, z=(-1.76), p=0.07<0.10, and the null hypothesis is rejected at 10% level of significance. In line with literature the net profit ratio of more than 10% is considered as good. In the present study, it is found the percentage of net profit is above 10% for both medium and large sized vessels. However, the net profit percentage was higher for medium size vessels as compared to the large size vessels.

4. *Efficiency Ratios*

i. *The catch per trip* (*in kgs*): The catch per trip (in kgs) is more for large vessels as they go for multi-day deep sea fishing bringing more catch. There was no statistically significant difference in the variable fish catch per trip across the size of vessels, U=452, z=(-1.55), p=0.12>0.05, hence failing to reject the null hypothesis at 5% level of significance.

ii. *Labour Productivity* (*Catch per labour in kgs*): In terms of labour productivity the catch per labour is higher for large vessels as compared to medium vessels. The reason is that on an average 31 labourers are employed per large vessel. The labour productivity is not statistically significantly different across the size of vessels, U=572, z =(-0.10), p=0.91>0.05, hence, failing to reject the null hypothesis at 5% level of significance.

iii. *Labour Productivity* (*Gross revenue per man days*): The labour productivity per man day is not statistically significantly different across the size of vessels, U=541, z =(-0.47), p=0.63>0.05, hence failing to reject the null hypothesis at 5% level of significance. The gross revenue (earnings) earned per labour by the fishermen owning large vessels is more than the medium vessels. The medium as well as large purse-seine vessels provide lot of employment opportunities to the labour in Goa.

iv. *Capital per labour*: There is statistically significant difference between the capital per labour against the size of the vessels, U=221,z =(-4.33), p=0.00<0.05, and hence the null hypothesis is rejected at 5% level of significance. The capital invested per labour is higher for large vessels, as large vessels require more manpower to carry out purse-seine fishing operations. Hence, they employ more capital per labour as compared to the medium vessels.

5. *Cost volume profit analysis* (*Marginal Efficiency*)

i. Break even sales (percentage): The Break even analysis is used to examine whether they can survive and sustain in business. The break even sales percentage was statistically significantly different against the size of the vessels, U=364, z=(-2.61), p=0.009<0.05, hence, the null hypothesis is rejected at 5% level of significance. In the study, it is found that the respondents who own large vessels had higher break even sales percentage as compared to the medium vessels.

ii. *Profit Volume ratio*: There is no much variation of profit volume ratio among both sizes of the vessels. The profit volume ratios were not statistically significantly different across the size of vessels, U=542, z =(-0.46), p=0.64>0.05, hence failing to reject the null hypothesis at 5% level of significance.

iii. *Margin of safety* (in percentage): The margin of safety were statistically significantly different across the size of the vessels, U=359, z=(-0.45), p=0.009<0.05, hence, the null hypothesis is rejected at 5% level of significance. The margin of safety is higher for large sized vessels compared to the medium sized purse-seine vessels.

The overall results of all the ratios discussed, in table 7.23 shows that the input output ratio is higher due to high operating costs. Higher the operating ratio, lower is the capital productivity and vice-versa. Capital efficiency is high as respondents could recover the cost incurred on capital investment on the vessel. The profitability ratio which is above 10% indicates that the respondents earn reasonable profits from fishing business. Labour productivity (efficiency) is comparatively higher for large size vessels than the medium vessels as they get more fish catch. Large purse-seine vessels have proved to be efficient in terms of labour and have further scope for increasing labour on the vessel as more manpower helps in carrying out fishing operations effectively. Marginal efficiency is high as both medium and large vessels achieved break even sales and margin of safety. The findings show that the fishermen owning both the medium and large sized purse-seine vessels earned reasonable profits for the period 2016-17, sufficient to cover their total costs, hence their fishing business was viable. The performance of medium vessels is better in terms of payback period, rate of return on investment, gross and net profit ratio. In case of large purse-seine vessels, performance is better than medium vessels in terms of catch, break even and margin of safety. The respondents also expressed that over the last 10 years due to overfishing, illegal fishing methods and several other factors have led to fish depletion resulting in less catch. The respondents expressed that there is uncertainty in fishing business as there is no guarantee that higher investment will result in more returns due to uncertainty of fish catch.

7.4 Summary

The present study was carried out to analyze the economic efficiency of purse-seine fishing business. The analysis of capital investment, total costs, earnings and profits shows that there are variations in capital investment, total costs, earnings and profits across the different sizes of vessels and across the jetties in Goa. It is evident from the study that the major portion of the capital investment incurred by the respondents is on the hull, engine and purse-seine nets. Besides this, reconditioning is also a major capital cost for aged vessels. Depreciation is a major element of fixed costs for medium and large vessels. The total costs ratio ranges between 73-85% and operating costs forming 75% of the total costs for both the sizes of vessels. The findings of the study also reveals that fuel costs is major component of the total operating costs ranging between 40-50% for all the sizes of vessels. This is also closer to the study by Aswathy et al., (2011) on purse-seine vessels in Kerala who finds that purse-seine vessel owners incurred expenditure of 49% on fuel costs.

The multiple regression model results shows that among all the socio-economic characteristics considered in the study, only two variables gender i.e male and caste OBC has statistically significant impact on net profit, earnings and savings from fishing business. Purse-seine fishing in Goa is male dominated. Females need to be encouraged to participate in the business as a means of augmenting their income by involving themselves in other fishing related activities. The linear regression model results indicate that the variable, district of South Goa has significant impact on the net profit, earnings and savings of fishermen. The log-log model of multiple regression using Cobb Douglas theory finds that wages paid to labour, fishing hours, fishing trips and expenditure on fuel has positive impact on earnings.

The findings of the study suggest that the medium and large sized vessels in Goa are economically and financially viable and generate reasonable revenue to cover fixed and variable costs for fishermen. They get sufficient gross profit and net profit and generate sufficient funds for reinvestment. However, the high percentage of operating costs is compensated by the respondents only due to continuing increase in the fish prices of the quality species of fish. Medium vessels are older in age as compared to large purse-seine vessels. Field enquiries from the opinion of the respondents revealed that large vessels are viable as compared to the medium size vessels. This is shown by the ratios in the present study. It is economical for the respondents to invest in large size vessels ranging between 65ft to 75ft. The large vessels have the competitive advantage of using more horsepower vessels, more registration tonnage capacity, bigger fish holds to store ice and fish, bigger purse-seine nets, venture into deep sea fishing and face the vagaries of nature. Besides this large vessels can carry more diesel and accommodate more labourers on the vessel. All these factors help respondents to bring more fish catch earning reasonable profits as compared to the medium vessels. In the present study all the respondents used fish finders on their vessels to locate the fish shoals and such equipment has helped them to reduce the searching time.

Based on the findings of the study, the following policy recommendations are suggested. There is further scope for the respondents of medium sized purse-seine vessels to enhance their revenue earned by them if they replace medium vessels with large size vessels. The Government can encourage the fishermen owning medium vessels to invest in large vessels by providing the subsidized loan facilities. It is recommended that the Government intervention through sound fishing regimes would ensure easy credit facilities through banks to the fishermen. Government could take policy decisions to enhance the existing subsidized 4% interest agricultural loan from

₹ 5,00,000 to higher amount with less than 4% subsidized rate of interest so that the fishermen could meet their financial requirement of fishing business to some extent. The purse-seine fishing activity is capable of creating additional employment, through Government support, augmenting income and improving the standard of living of the purse-seine owners in Goa.

This chapter provides a holistic view of the commercial aspects of the purse-seine fishing vessels in Goa. It will be more meaningful to study the role of the Government in the promotion of Fishing Business in Goa. The next chapter eight looks into these aspects of the problem.

Chapter 8

Role of Government in Promotion of Fishing Business in Goa

Chapter 8

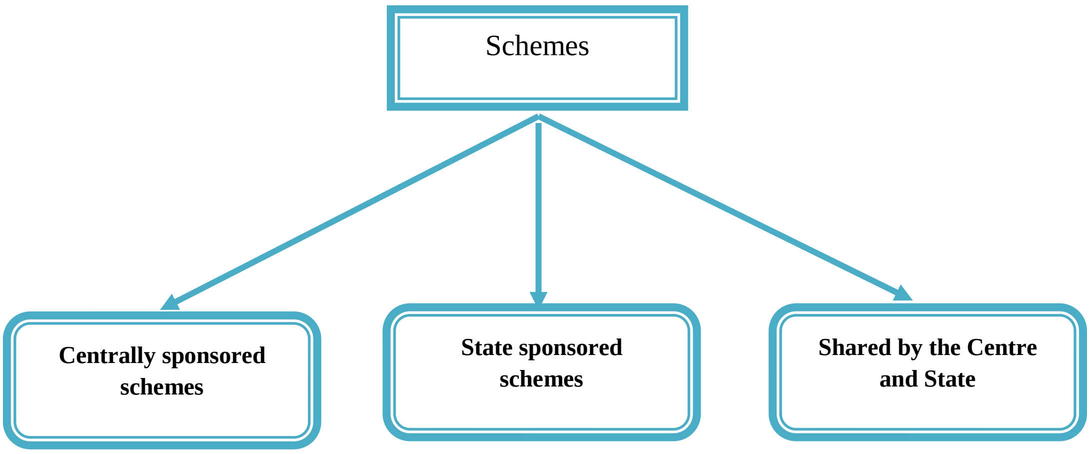
Role of Government in Promotion of Fishing Business in Goa

8.1 Introduction

The Fisheries subsidies have been prevailing in the developing countries for almost hundred years. In the late eighteenth century it was provided by Scotland, later in the nineteenth century by North Atlantic fishing countries and by the twentieth century, all the governments provided it for commercial fishing and improvements of port infrastructure facilities. The World Trade Organization WTO) defines subsidies under Article 1 of subsidies and countervailing measures as "Financial contribution by a government or public body within the territory to the member which confers a benefit". It is direct transfer of funds by the government such as grants, loans, fiscal incentives, provision of goods and services, price and income support (Steenblik, 2010). Subsidies are usually defined as financial support provided by the government to businesses for encouraging their activities which the government wishes to promote. Subsidies help to reduce the cost of fisheries operation both in terms of capital and operational cost and many a times it provides an incentive for fishers to increase their fish catch. It is believed that employment and social security can be achieved by reducing deprivation with the help of state instruments, such as subsidies (Kurien, 2006). Contrary to this, authors argue that subsidies in fisheries produce unfair production distortions and contribute to unsustainable fisheries across the world (Rosenberg, Fogarty, Sissenwine, Beddington, & Shepherd, 1993).

Fishing being an economic activity and a means of livelihood for a large majority of population all over the globe, governments support the activities through various schemes. Large amount of allocations are made by governments for this purpose. The Government of India has implemented various centrally sponsored schemes through which financial assistance is given for the social upliftment and for the welfare of the fishing community in India. The Central Government policy is to support all the maritime nine states and two union territories of India through centrally sponsored schemes. The main objective of the schemes is to develop the fisheries sector and uplift the socio-economic conditions to those dependent on the fishing industry. Over the past several five year plans, the number of Centrally Sponsored Schemes (CSSs) has been growing and large funds are being transferred to states under these schemes. The Department of Animal Husbandry, Dairy and Fishery (DAHD) under the Ministry of Agriculture and Farmers Welfare, Government of India, National Fisheries Development Board of India (NFDB) have been executing the centrally sponsored schemes since 1964 to provide infrastructure amenities for landing and berthing of traditional fishing crafts and mechanized deep sea fishing vessels. The schemes are percolating to the fishing community through the DAHD, MPEDA, NFDB, FISHCOPED, CMFRI, Fishery Survey of India which are the implementing agencies, apart from the state governments and the union territories. Since the tenth five year plan (2002-07) all the schemes are under Centrally Sponsored schemes, with the aim of developing marine fisheries, infrastructure, post-harvest operations, innovative activities and improving the socio-economic conditions of the fisher folk (Planning Commission Government of India, 2011). The Government of India directly and indirectly grants subsidies to the fishing sector. Direct subsidies are provided for aquaculture assistance, to claim fuel subsidy, acquire fishing gears, engines and vessels (Salim et al., 2009). However, indirect subsidies include the support provided for the development of market infrastructure and post-harvest market operations. The Government is also providing financial assistance for the infrastructure through building and development of ports, fish landing centres, and other welfare schemes. The schemes are classified based on the purpose as i) Schemes to develop the fishing sector and ii) Schemes to improve the socio-economic conditions of the fishermen. The classification of schemes is given in figure 8.1.

Figure 8.1 Classification of Schemes to Support Fishermen



The schemes are categorized based on the agency which financially supports them. They are;

i. Centrally sponsored schemes - These are schemes fully sponsored by the central government
ii. State sponsored schemes - These are schemes fully sponsored by the state government
iii. Centre and state sponsored schemes - Schemes under which financial assistance given to the fishing industry is shared by the center and the state.

The Blue Revolution scheme was started in 1970 in India during the fifth five year plan and sponsored by the Central government namely Fish Farmers Development Agency (FFDA). Realizing the great scope for the development of fisheries sector and overall development of the country, Prime Minister called for a total change in the fisheries sector and revised the “Blue Revolution” or the Neel Kranti Mission. The Ministry of Agriculture and Farmers Welfare, through the DAHD has accordingly restructured the scheme by merging all the ongoing schemes under an umbrella of Blue Revolution to be implemented during five years from 2015-16 to 2019-20 (Government of India, 2016). The restructured blue revolution scheme in 2016 has the vision to achieve economic prosperity of the country. It will provide financial assistance to the fishers. It will contribute towards food and nutritional security through full potential use of water resources for fisheries development in a sustainable manner, keeping in view the bio-security and environmental concerns. This restructured scheme will cover inland fisheries, aquaculture and marine fisheries including deep sea fishing, mariculture and all activities undertaken by the NFDB towards realizing the objectives of “Blue revolution”. Government of India approved the implementation of the revised Central Sector Scheme, namely; “Blue Revolution -Inland Fisheries” during the financial year 2014-15 at an outlay of ₹ 50 crores, of which 16.6% is earmarked for Scheduled Caste Sub Plan (SCSP) and 10% for North East Region (Government of India, 2016).

Government of India and Government of Goa are implementing a number of development and welfare schemes for the welfare of the fishing industry. So far no attempt has been made to analyze the impact of various welfare schemes for the development of the people engaged in fishery industry; especially from the point of view of motorized and mechanized boat owners in Goa. These schemes are in the form of subsidies, supplies of material, grant-in-aid and contribution given for the welfare of the fisheries sector. The researcher was interested in understanding the extent to which the financial assistance is disbursed to the traditional and mechanized fisheries sector and to examine whether the fishermen owning motorized and mechanized vessels are satisfied with these schemes. The sub-objectives outlined are as follows:

1. To study the trends and extent of financial assistance through different schemes provided by the government for the welfare of the fishermen in Goa.
2. To study the satisfaction level of the fishermen owning motorized canoes and mechanized fishing vessels as regards the schemes availed by them in Goa.
3. To analyze the satisfaction of the fishers owning mechanized vessels regarding the facilities provided by the fisheries co-operative societies in Goa.
4. To study the problems faced by fishermen in fishing business in Goa.

An intermittent evaluation of the financial assistance is essential to estimate the effectiveness of such schemes. The researcher has reviewed the literature on such evaluations and the same is being examined here. Literature shows that subsidies are classified into three categories, namely; capacity enhancing, beneficial and ambiguous. A study by Sumaila et al., (2016) on global fisheries, shows that capacity enhancing subsidies are higher for all countries except in case of North America where it has higher beneficial subsidies. The study finds that developed countries provide higher subsidies (65% of the total subsidies) as compared to developing counties which provide (35% of the total subsidies) to the marine sector. The developed countries allocate 22% towards fuel subsidies, 20% for management, and 10% for development of ports and harbours. Rashid et al., (2010) examined the global fisheries subsidies by considering 25 types of non-fuel fishery subsidies given in 148 maritime countries. This study indicates that the quantum of subsidies provided by governments to the fishery sector is huge and they lead to overcapacity and overfishing. Further, Porter (2001) analyzed fisheries subsidies and overfishing and suggested that member countries should shift from giving ‘harmful’ subsidies to ‘beneficial’ subsidies that contribute to the sustainability of marine resources, including conservation, research and creation of marine protected areas.

A study by Sackey-Mensah (2013) found that the fuel subsidy given to Ghana's marine artisanal fisheries sector directly enhances capacity. According to their study, fuel subsidy helped to improve the livelihood of fishermen, helps sustainable usage of the fisheries resources, improve costs which would further reduce overexploitation. Clark, Munro, & Sumaila, (2005) in their study highlighted that subsidies are perceived as an important reason for resource exploitation, over capacity, negative environmental, social and economic effects. Islam, Gazi, Ali, Zamhuri, & Kuperan, (2016) in their study on 246 small scale fisheries in Malaysia found that subsidies neither helps in improvement of income of small scale fishers nor promotes sustainable fishing. However, they conclude that overexploitation of marine resources cannot be controlled by reducing or eliminating the subsidies but through effective planning by policy makers which will benefit the small artisanal fishermen. Duy & Flaaten, (2016) examined the effects of government subsidy on the profitability of fishermen in Vietnam using offshore gill net fishing. They studied the costs and earnings of fishing vessels and found that the subsidy given by the government had positive effects on the cash flows of the large vessels. The fishers owning these vessels benefitted due to subsidy but the benefits did not filter to the crew members. John, Jagadish, Bhatta, & Sridhar, (2014) examined the perceptions of small-scale fishers, towards subsidies availed by them in the state of Karnataka. They found that subsidies and state intervention are important for the sustainability of small-scale fisheries all over the world and promote sustainable fishing practices. They suggest that there is a need for the government to create awareness among fishers regarding subsides availed as well also to adopt sustainable fishing. They also recommend that banning nets with small mesh size, high speed engines, and destructive gears will help to manage the depleting marine resources.

8.2 Data Sources and Techniques

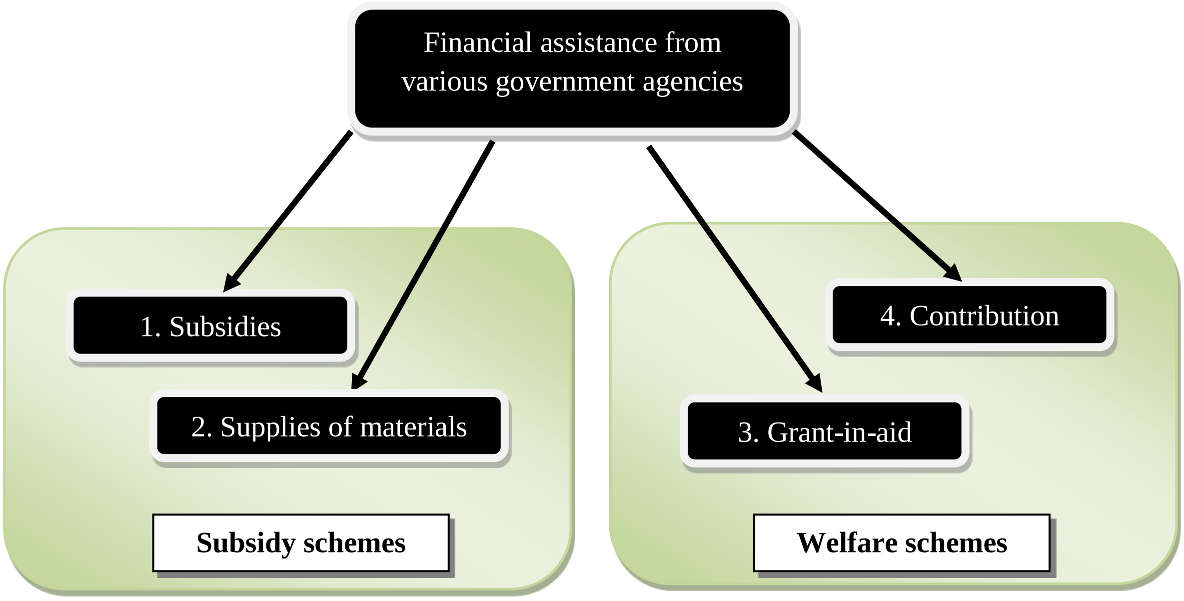
The secondary data regarding expenditure incurred by the government on the fisheries schemes in the form of subsidies, supplies of material, grant-in-aid and contribution, is collected from the Demand Book published by the Government of Goa for the financial years 1990-2018. The CAGR of the schemes is analyzed for the period 1990-2018. The CAGR method is given in Research methodology chapter in section 3.8.5, equation 3.5. The secondary data as regards the number of fishermen (beneficiaries) who availed of the schemes is obtained from the Fisheries Department, Government of Goa for the financial years 2012-18. The study also uses primary data collected from the fishermen owning motorized fishing canoes and mechanized vessels in Goa for the year 2016-17. The schemes are analyzed using descriptive statistics such as percentage and averages of the amount spent by the government for the period 2012-2018. Friedman's test is used to analyze whether the mean ranking given by the respondents is random. Fishers test is also used for the variables in cases where frequency is less than five. The Independent sample *t* test is used to compare the significant difference in the variables regarding the satisfaction level of the fishermen towards the schemes availed by them. It is also used to examine the satisfaction level of fishermen as regards economic and social factors affecting their fishing business. The Independent sample *t* test is used to study the facilities provided by the fisheries co-operative societies to the fishermen owning mechanized vessels. It is also used to analyze whether there is a significant difference in the problems faced by the fishermen in fishing business in Goa.

8.3 Results and Interpretation

The development of the fisheries sector is one of the major objectives of the Government of Goa and is necessitated by the fact that approximately 30,225 fisherfolk population (as per marine census of Goa 2011) of Goa depend on fishing for their source of livelihood. In order to grant relief to the fishermen and to recover financial losses from their fishing business, the Central Government as well as the State Governments has implemented various schemes for the welfare of the fishing community. The Government of Goa implements the fisheries development programmes through the Directorate of Fisheries. In Goa, both the traditional and mechanized sector receives the financial assistance from the state and central government.

During the period of this study, under the category of schemes, there were 10 subsidies, nine related to capture fishing directly given to the fishermen and one towards brackish water aquaculture farm. There are six welfare schemes under grant-in-aid, three under contribution and three towards supplies of subsidized material to the fishermen. In order to avail the various schemes, beneficiaries (fishermen) must have their boats registered with the Fisheries Department, Government of Goa. The fishermen owning the fishing crafts should also have the ownership certificate, registration certificate, fishing license and biometric fisher's identity card to claim these schemes. Figure 8.2 explains the financial assistance of the various schemes.

Figure 8.2 Financial Assistance through Schemes from Various Government Agencies



The following sections examine the financial support in the form of schemes provided by the government, namely; subsidies, supplies of materials, categorized as subsidy schemes and grant in aid and contribution under the welfare schemes. Under the contribution schemes, the central and the state government as well as the fishermen also contribute towards some schemes.

8.3.1 Subsidy Schemes

a) Financial assistance to fishermen for purchase/construction of wooden or Fibre Reinforced Plastic (FRP) canoe

Objective: This scheme is introduced by the State Government before 1990-91 to provide subsidy to fishermen to construct/purchase wooden canoes. The objective of this scheme was to support the traditional fishermen by giving them financial help in the form of subsidy for construction/purchase of FRP/ wooden fishing craft.

Eligibility and extent of subsidy: Under this scheme the State Government allows only the traditional fishermen to construct or build motorized canoes from size 26 to 38 feet. Traditional fishermen will be entitled to avail the financial assistance after every four years. The financial assistance in the form of subsidy is granted by the state government and financed through nationalized banks/financial institutions or self-finance (Initially fishermen spend and later government reimburses the amount). Under this scheme, traditional fishermen can avail 50% of the cost limited to ₹ 60,000/- per fishing canoe.

Table 8.1 shows that the number of beneficiaries who availed this scheme is not constant. As shown in table 8.1, the average amount sanctioned by government per traditional fishermen owning motorized canoe, is ₹ 41,569 in 2012-13, ₹ 58,289

Table 8.1 Financial Assistance to Fishermen for Purchase/Construction of Wooden or Fibre Reinforced Plastic Canoes

Construction of wooden / FRP canoe	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	29.93	66.45	43.23	54.90	13.14	46.51	**254.16**
Number of Beneficiaries	72	114	73	93	22	83	**457**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

in 2013-14, ₹ 59,219 in 2014-15, ₹ 59,032 in 2015-16, ₹ 59,727 in 2016-17 and ₹ 56,036 in 2017-18 which was received by the beneficiaries.

b) Financial Assistance for traditional fishermen for procurement of FRP boats upto 10 meters

Objective: This scheme was introduced in 2016 by the Government of India, a centrally sponsored scheme under the Blue Revolution. Under this scheme, the traditional fishermen were given financial assistance for procurement of FRP canoe upto 10 meters.

Eligibility and extent of subsidy: These schemes can be availed by the traditional fishermen who have registered their motorized as well as non-motorized wooden canoes with the Fisheries Department. The fishermen who wish to construct new FRP canoes of 10 meters have to scrape/replace their old canoes in order to avail this scheme. Under this scheme, the Central Government provides 50% of the cost of canoe up to a maximum of ₹ 2,00,000 and ₹ 12,500 for ice box. Thus, each beneficiary can avail up to a maximum of ₹ 2,12,500 per canoe. During the year 2017-18, the Central Government sanctioned under this scheme a total amount of ₹ 49,55,881 and it was totally utilized. This scheme benefitted 50 applicants and each beneficiary received on an average ₹ 1,98,235 per canoe.

c) **Financial Assistance for traditional fishermen for procurement of fishing crafts and fishing gears**

Objective: The Central Government announced financial assistance to the traditional fishermen to purchase crafts and gears under the Blue Revolution banner from 2016.

Eligibility and extent of subsidy: Traditional fishermen can procure craft without motor and gear only for inland fishing and the length of the canoe should be below 26 feet i.e 7.92 meters. The traditional non-motorized canoe can get 50% of the cost limited to ₹ 50,000 per canoe. During the year 2017-18, the Central Government sanctioned ₹ 23,74,143 and it was fully utilized. The Fisheries department gave the benefit to 50 applicants. Each beneficiary received an average subsidy of ₹ 47,482.

d) **Financial assistance to fishermen for purchase of fisheries requisites (Gill nets with accessories)**

Objective: This is a state sponsored scheme introduced by the government with the principal objective to help the fishermen to maintain their livelihood by giving them subsidy to purchase fisheries accessories.

Eligibility and extent of subsidy: Traditional fishermen who belong to the general and the OBC category and who have registered their canoes can avail of the scheme after every four years. The beneficiary is entitled for subsidy upto 50% of the actual cost limited to ₹ 30,000 to purchase gill nets with accessories through bank finance or self-finance. This subsidy is of great help to the fishermen as they can get reimbursement of a portion of the expenditure on fishing gears/nets. This provides great relief to the fishermen as their nets get frequently destroyed. Table 8.2 shows

Table 8.2 Financial Assistance to Purchase Gill nets and other Accessories

Financial Assistance to Fishermen for purchase of Fishery Requisites	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	11.78	13.4	16.33	14.84	14.76	16.04	**87.15**
Number of Beneficiaries	50	50	56	50	50	54	**310**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

that an average amount received by each beneficiary in 2012-13 is ₹ 23,560, ₹ 26,800 in 2013-14, ₹ 29,161 in 2014-15 ₹ 29,680 in 2015-16, ₹ 29,520 in 2016-17 and ₹ 29,703 in 2017-18.

e) Tribal Sub Plan for Schedule Tribe (ST) Development Scheme

Objective: This scheme was started in 2008-09, whereby the fishermen belonging to ST category can avail reimbursement of a portion of the expenditure on the purchase of wooden or FRP canoe, gill net and outboard motor. Amendment was made to this scheme in 2017-18 under which male fishermen belonging to SC/ST and women from OBC category will get 60% subsidy which amounts to ₹ 72,000 of which i.e 60% of the amount i.e ₹ 43,200 is borne by the centre and balance 40% amount of ₹ 28,800 is given by the state, whereas the female fishermen and fishermen belonging to SC/ST can avail 60% of the subsidy limited to unit cost of ₹ 120,000 per OBM motor.

Table 8.3, shows that the average subsidy given to each fisherman is ₹ 50,000,

Table 8.3 Tribal Sub Plan for Schedule Tribe Development Schemes

Tribal sub Plan for Schedule Tribe Development Scheme	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	22	20	46.27	51.76	12	12	**164.03**
Number of Beneficiaries	44	40	68	111	7	30	**300**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

in 2012-13, ₹ 50,000 in 2013-14, ₹ 68,044 in 2014-15, ₹ 46,631 in 2015-16, ₹ 171429 in 2016-17, and ₹ 40,000 in 2017-18 respectively.

f) Interest subsidy scheme on loans for agriculture and allied activities:

Objective: The scheme was started in the year 2009-10. The government provides credit facilities to the fishermen at subsidized rate of interest to accelerate the fishing activities and to purchase the canoes, outboard motors, fishing nets, fish finders, fish holds, GPS for fishing vessels, and modification of fishing crafts. Under this scheme, the fishermen can avail loans from listed banks, where out of the total rate of interest they need to pay only 4% and the balance will be borne by the Government.

Eligibility and extent of subsidy: In order to avail the loan facility the fishermen have to approach the designated banking institutions. Under this scheme fishermen can avail loan upto ₹ 5.00 lakhs after every five years. As per table 8.4, each beneficiary

Table 8.4 Interest Subsidy on Loans for Fisheries and Allied Activities

Interest Subsidy on loans for Fisheries	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	24.98	21.34	18.19	12.99	4.27	5.59	**87.36**
Number of Beneficiaries	10	197	172	101	22	25	**527**

Source: Compiled by researcher, from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

beneficiary received on an average a subsidy on interest of ₹ 249,800 in the year 2012-13, ₹ 10832 in 2013-14, ₹ 10,576 in 2014-15, ₹ 12,861 in 2015-16, ₹ 19409 in 2016-17, and ₹ 22,360 in 2017-18.

g) Financial assistance for purchase of outboard motors:

Objective: This scheme was implemented from 2010-2011 and is in force for the last eight years. Under this scheme, Government provides subsidy only to the traditional fishermen to purchase outboard motor.

Eligibility and extent of subsidy: The beneficiary is entitled for financial assistance to the extent of 50% on the cost of OBM in which ₹ 15,000/- is borne by the centre and the rest ₹ 45,000/- by the state government till 2015-16. Later in 2016-17 the amount was enhanced to ₹ 90000 under Blue Revolution Scheme (Official Gazette, series 1, No 36, dtd, 6th Dec, 2012). As per the amendment, the beneficiary is entitled for financial assistance to the extent of 75% of the cost limited to ₹ 90,000 of which 25% to be borne by state ₹ 30,000 and 50% i.e ₹ 60,000 by the centre. However, in 2017-18, amendments were made to the scheme and the government gave 40% subsidy on the unit cost of OBM. Under this scheme, a traditional male fishermen belonging to OBC category can avail 40% subsidy of the cost limited to unit cost of ₹ 120,000/- per OBM. Thus, the subsidy of ₹ 48,000 is given to the fishermen of which 60% i.e ₹ 28,800 is given by the centre and 40% i.e ₹ 19200 is borne by the state.

Table 8.5 shows that each beneficiary received on an average ₹ 56,472 in 2012-13,

Table 8.5 Financial Assistance for Purchase of Out Board Motors (OBM)

Financial Assistance for construction/Purchase of OBM	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	29.93	12	28.20	31.80	22.50	18	**142.43**
Number of Beneficiaries	53	20	47	53	25	60	**258**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

and from 2013-2016 each beneficiary received an amount of ₹ 60,000 towards the purchase one petrol OBM.

h. Financial assistance to the fishermen for purchase of fuel (kerosene/petrol) to operate Out Board Motors (OBM)

Objective: This scheme was introduced in 2010-11 by the State Government to help the fishermen in getting a regular supply of fuel i.e kerosene/petrol (Official Gazette Series 1, No 48, February, 2013).

Eligibility and extent of subsidy: The fishermen who use petrol OBM are eligible for subsidy of ₹ 30/-per litre on a maximum consumption of 1200 litres of petrol. The beneficiary can claim the same every year. The fishermen using kerosene OBM shall be eligible for subsidy upto a maximum of ₹ 50,000/- as follows:

Quantity of kerosene consumed in litres	**₹ per annum**
a.2000 litres	50,000
b.1500-1999 litres	37,500
c.1000-1499 litres	25,000
d.500-999 litres	18,000 (General category)
	20,000 (SC/ST category)
Quantity of Petrol consumed in litres	₹ per year
1700litres of petrol consumed	51,000

Source: Data of Directorate of Fisheries, Government, Goa.

The maximum consumption of fuel from 2016 is enhanced from 1200 litres to 1700 litres. In the midyear the fishermen can shift from kerosene to petrol on pro-rata basis but once they claim petrol subsidy they cannot claim kerosene subsidy. The subsidy is released annually towards the purchase of kerosene per annum on maximum consumption of 2000 litres, (Official Gazette Series 1, No 18, August, 2016).

Table 8.6 shows that the average amount received as fuel subsidy by each beneficiary is ₹ 49,485 in 2012-13, ₹ 49,043 in 2013-14, ₹ 40,371 in 2014-15, ₹ 45332 in

Table 8.6 Financial Assistance for Purchase of Fuel (Kerosene/Petrol) to the Fishermen for Operation of Out Board Motors (OBM)

Financial assistance for fuel	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	499.8	576.75	469.93	500.46	539.33	537.61	**3123.88**
Number of beneficiaries	1010	1176	1164	1104	1100	1096	**6650**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

2015-16, ₹ 49030 in 2016-17 and ₹ 49,052 in 2017-18. The fuel subsidy is restricted to a maximum consumption of 2000 litres per year from August to May.

h) Financial assistance on Goa value added tax based subsidy (100 % VAT reimbursement) on high speed diesel oil (H.S.D) consumed by fishing vessels

Objective: The Goa Value Added Tax subsidy scheme on high speed diesel oil consumed by mechanized fishing vessels was introduced in 2011-12 by the state government (Official Gazette, Notification, dtd.10/3/2016). The Government provides this scheme every year to the fishermen, where in a fishermen can claim 100 % VAT reimbursement on diesel only on two mechanized vessels (trawler and purse-seiners) for entire fishing season from August to May.

Eligibility and extent of subsidy: The fishermen owning mechanized vessels having a valid net and fishing license should be registered under the Goa Daman and Diu Marine Fishing Regulation Act, 1980 (3 of 1981). The vessel owner should purchase diesel from the outlet run by registered fishermen co-operative society or outlets approved by the Government of Goa. The total quota of H.S.D oil for the purpose of this scheme shall be restricted to 20,000 K.L per financial year for the entire fishing industry. Fishing vessel fitted with engine of 3 cylinders get a maximum 15,000 Lts, 4 cylinders get 20,000 Lts, and 6-8 cylinders get 30,000 Lts on actual fuel consumption.

As per table 8.7, the number of fishermen owning mechanized trawlers and purse-seine vessels claiming this subsidy has increased over the years. The average amount paid by government for reimbursement of 100% VAT diesel subsidy per

Table 8.7 Financial Assistance on 100% Goa Value Added Tax Reimbursement based Subsidy on Diesel for Mechanized Vessels

Financial Assistance on Goa Value Added Tax (VAT) fuel subsidy	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	1039.87	1463.73	1499.97	1379.92	746.56	1130.07	**7260.12**
Number of Beneficiaries	675	662	679	680	771	620	**4087**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

beneficiary is ₹ 1,54,055 in 2012- 13, ₹ 2,21,107 in 2013-14, ₹ 2,20,909 in 2014-15 and ₹ 2,02,929 in 2015-16, ₹ 96,830 in 2016-17 and ₹ 1,82,269 in 2017-18.

i) Financial assistance for replacement of old kerosene Outboard to petrol Outboard Motor

Objective: The Government of Goa, through a scheme replaced old kerosene OBM with petrol OBM in 2013-14, due to the scarcity of kerosene. The cost of petrol OBM was high, and unaffordable. Subsidy was provided for replacement of old kerosene OBM to petrol OBM.

Eligibility and extent of subsidy: Subsidy was allotted to the owners of registered operational canoes with OBMs installed on them. The subsidy was to the extent of 98% and was used for the installation of 2-stroke/4-stroke petrol OBM which consumes less petrol and is environmental friendly.

As per table 8.8, under the replacement of old kerosene OBM to petrol OBM scheme, each beneficiary received financial assistance of an average amount of

Table 8.8 Replacement of Old Kerosene OBM to Petrol OBM

Replacement of kerosene OBM to petrol OBM	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	206.65	469.93	447.69	94.1	80.22	**1298.58**
Number of beneficiaries	176	408	389	82	67	**1122**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

₹ 1,17,415 in 2013-14, ₹ 1,15,179 in 2014-15, ₹ 1,15,087 in 2015-16, ₹ 114,756 in 2016-17, and ₹ 1,19,731 in 2017-18 respectively.

j) Inte-Brackish Water Aquaculture Farm

Objective: The Government started this scheme in 2013-14 to increase the fish production through aquaculture activities in the coastal areas of Goa. The subsidy is given to renovate aquaculture farm, purchase equipment, fish and shrimp feed.

Eligibility and extent of subsidy: This subsidy is given to fish and shrimp farmers who have farms registered with an area of less than or equal to 2 acres. The aquaculture farmers will get subsidy of 25% of the cost of construction limited to ₹ 2,00,000 per hectare, out of which ₹ 45,000 will be given by the central government and ₹ 1,55,000 by the state government. Subsidy for feed is given on an annual basis. Under this scheme, subsidy is allotted for renovation and for the purchase of equipment every five years.

Table 8.9 shows that each beneficiary received an average of ₹ 161750 in

Table 8.9 Inte-Brackish Water Aquaculture Farm

Inte -Brackish water Aquaculture farm	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	1.71	12.94	10.73	7.42	3.21	**36.01**
Number of Beneficiaries	Nil*	8	8	5	8	**29**

Note: *Beneficiaries did not apply for the subsidy**. Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

2014-15, ₹ 1,34,125 in 2015-16, ₹ 148400 in 2016-17, and ₹ 40,125 in 2017-18 respectively.

k) Financial assistance for purchase of power block

Objective: This scheme was started in 2014-15 to assist the fishermen owning mechanized purse-seine vessels to provide power blocks.

Eligibility and extent of subsidy: The beneficiary will be entitled for financial assistance to the extent of 25% of the cost, limited to ₹ 1,50,000, to purchase power blocks if they have licensed vessels and can avail this subsidy once in their life time.

Table 8.10 shows the financial assistance availed by fishermen for the purchase of power blocks per mechanized purse-seine vessel. Fishermen received an

Table 8.10 Financial Assistance for Purchase of Power Blocks

Subsidy for purchase of Power Blocks	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value in (₹ in Lakhs)	8.73	10.92	10	12.01	**41.66**
Number of Beneficiaries	7	8	Nil*	Nil*	**15**

Note: *Beneficiaries did not apply for the subsidy, **Source**: Compiled by researcher, from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

average amount of ₹ 1,24,714 in 2014-15 and ₹ 136,500 in 2015-16. This shows that there was very poor response for this scheme.

8.3.2 Government Support through Supplies of Material

a) Financial assistance for supply of insulated boxes:

Objective: This scheme was started in 2001-02, with the exclusive aim to create an awareness of hygiene among the fishermen and to preserve the fish in fresh condition.

Eligibility and extent of subsidy: Under this scheme, the fishermen owning canoes without OBM involved in selling of fish get 75% of the cost limited to ₹ 1500/- per insulated box. However, fishermen owning OBM canoe get subsidy of 75% of the cost, restricted to ₹ 3,000 per box and fisherman having mechanized vessels between 3-6 cylinders get 75% subsidy of the cost limited to ₹ 4,000 per insulated box.

Table 8.11, shows that the government has spent on an average ₹ 5231 in

Table 8.11 Supply of Insulated Boxes to Fishermen

Supply of Insulated boxes to Fisher Persons	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	7.48	9.80	4.96	16.89	13.83	9.73	**62.69**
Number of Beneficiaries	143	291	421	504	315	59	**1733**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

2012-13, ₹ 3368 in 2013-14, ₹ 1178 in 2014-15, ₹ 3351 in 2015-16, ₹ 4390 in 2016-17 and ₹ 16492 in 2017-18 per beneficiary on the insulated boxes. The beneficiaries have not received the amount on insulated boxes but the government has supplied insulated boxes free of cost to the fishermen, wherein the fishermen spend 25%.

b) Safety of fishermen at sea

Objective: This scheme was started in 2010-11 to ensure the safety of the fishermen at sea. It provides a subsidy for the procurement of safety gadgets.

Eligibility and extent of subsidy: Under this scheme 75% of the unit cost of safety kit is provided by the government to fishermen after every five years limited to ₹ 1,50,000. As much as 75% of the cost is borne by the Central Government and 25% is borne by the beneficiary.

As per the table 8.12, the amount spent by the government on an average for

Table 8.12 Safety Equipment for Fishermen at Sea

Safety Equipment	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	73.35	6.14	159.37	40.66	100	Nil***	**379.52**
Number of Beneficiaries	86	338	338	338	Nil	Nil*	**1100**

Note: ***Beneficiaries did not apply for the subsidy, ** *** Subsidy amount not sanctioned by government,
Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

each beneficiary was ₹ 85,291 in 2012-13, ₹ 1,817 in 2013-14, ₹ 47,150 in 2014-15, ₹ 12,030 in 2015-16. In 2016-17, an amount of rupees one crore was sanctioned by the Central Government to the State Government, but the fishermen did not apply for the same.

c) Financial assistance for purchase of life jackets and lifebuoys for the fishing vessels

Objective: This scheme was implemented in 2012-13 to provide safety equipment's for the fishermen at sea. (Official, Gazette, Series 1, No.44, 2011). It is mandatory for all traditional and mechanized fishing vessels to carry life jackets and lifebuoys on board.

Eligibility and extent of subsidy: This financial assistance is given by the government after every five years to the extent of 75% of the cost of life jackets/lifebuoys.

Amendments: The scheme is amended w.e.f from April 2016, and it is implemented on 50:25:25 sharing basis, the central share is 50%, state share is 25% and beneficiaries share is 25% (Official Gazette Series 1 No 41, dtd, 12th January 2017).

Table 8.13 shows that the financial assistance for purchase of safety jackets and life buoys for the fishing crafts was availed by fishermen owning traditional and

Table 8.13 Financial Assistance for Purchase of Safety Jackets and Life Buoys for the Fishing Crafts

Financial assistance for safety jackets & life buoys	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	8.28	0.99	7.82	8.45	1.77	Nil***	**27.31**
Number of Beneficiaries	88	11	13	185	50	Nil*	**347**

Note*Beneficiaries did not apply for the subsidy **, ** *** Subsidy amount not sanctioned by government**,**
Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

mechanized vessels. The average amount spent by the centre and state government on safety jackets and life buoys per beneficiary was ₹ 9409 in 2012-13, ₹ 9000 in 2013-14, ₹ 60154 in 2014-15, ₹ 4568 in 2015-16, and ₹ 3540 in 2016-17.

The welfare schemes are classified under grant-in-aid and contribution by the government.

8.3.3 Grant-in-aid Welfare Schemes

a) National Welfare Fund for Fishermen (Saving cum relief scheme)

Objective: This is a centrally sponsored scheme started in 2004-05 and its main objective is to provide relief to the APL as well as BPL fishermen during the lean season.

Eligibility and extent of subsidy: The fishermen who want to avail this scheme should be between 18-60 years and has to contribute ₹ 100 for 9 months and the Central and State government contribute on 50:50 basis, ₹ 900 by the state government and ₹ 900 by the centre. An amount of ₹ 2700 is given to the fishermen in three equal monthly installments of ₹ 900 each during the lean season June, July and August.

Amendments: The scheme was amended in 2016, enhancing the amount from ₹ 2,700 to ₹ 4,500. Since, 2016, this scheme is restricted only to BPL fishermen.

The Table 8.14 shows that the average amount disbursed per beneficiary is ₹ 1,255 in 2012-13, ₹ 1,249 in 2013-14, same amount of ₹ 1,800 in 2014-15, 2015-16,

Table 8.14 National Welfare Fund for Fishermen (Saving Cum Relief fund) Grant-in-Aid

National Welfare Fund for Fishermen	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	66.06	73.2	102.73	93.55	97.48	97.48	**530.5**
Number of Beneficiaries	5265	5860	5707	5197	5416	5416	**32861**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

and 2016-17 respectively. An amount of ₹ 900 was given by the state and ₹ 900 by the centre government towards each beneficiary.

b) Development of model fishermen village (Housing)

Objective: This scheme has been introduced in 2010-11 to support the traditional fishermen community to construct new house/renovate the kacha structure.

Eligibility and extent of subsidy: Beneficiary should be actively involved in fishing activities. Preference is given under this scheme to the fishermen living below poverty line. Beneficiary will be eligible for the financial assistance of ₹ 75,000 and can avail the subsidy once in their life time.

Table 8.15, shows that in the year 2012-13 each beneficiary received ₹ 50,000, ₹ 37,500 in 2013-14, ₹ 30,000 in 2014-15, ₹ 25,000 in 2015-16 and in 2017-18 each

Table 8.15 National Welfare Fund for Development of Fishermen Village for Housing

National welfare fund for development of fishermen village housing	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	1.5	0.75	1.5	0.75	4	0.75	**9.25**
Number of Beneficiaries	3	2	5	3	Nil *	2	**15**

Note*Beneficiaries did not apply for the subsidy**, Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

beneficiary received an amount of ₹ 37,500 for construction and renovation of the house.

c) Financial Assistance to Registered Fishermen Societies/ Associations

Objective: This scheme was started since 2013-14 to help the fishermen associations/ co-operative societies in meeting the expenses of administrative cost.

Eligibility and extent of subsidy: All Fishermen Societies/Associations registered under the Co-operative Societies Act shall be eligible for financial assistance every year to the extent of ₹ 50,000/- as grant-in-aid.

Table 8.16 depicts that the government provided ₹ 50,000 per year to each society/associations for its functioning from 2013-14 till 2015-16. In 2016-17 and

Table 8.16 Financial Assistance to Registered Fishermen Societies/ Associations

Financial Assistance to Registered Fishermen Societies/ Associations	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	Nil***	3.5	2	0.5	8	1	**15**
Number of Beneficiaries	Nil*	7	4	1	Nil*	Nil *	**12**

Note*Beneficiaries did not apply for the subsidy**, ***** Subsidy not implemented by government**, Source**: Compiled by researcher, from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

2017-18, the beneficiaries did not apply to avail the amount, though amount was sanctioned by the government.

8.3.4 Contribution towards Welfare Schemes

a) Group Accident Insurance Scheme for Active Fishermen

Objective: This is a Central Government scheme implemented from 2008-09 by which the active fishermen were provided with insurance cover as they are prone to accidents in the sea.

Eligibility and extent of subsidy: Licensed registered fishers in the age group of 18-70 years are eligible for insurance cover for one year under this scheme.

The compensation available under the scheme is as follows:

Annual premium per beneficiary (shared by centre and state) 50:50 basis	₹ 20.27
On death due to accident at sea	₹ 2,00,000
Permanent /total disability due to accident at sea	₹ 2,00,000
Partial permanent disability due to accident at sea	₹ 1,00,000
Partial permanent disability due to accident at sea	₹ 50,000
Cover towards hospitalization expenses in the event of accident	₹ 10,000

Source: Data of Directorate of Fisheries, Government, Goa.

Amendments: From 2016 onwards, this scheme is limited only to the BPL fishermen. Table 8.17, indicates that the government has invested on premium per beneficiary ₹

Table 8.17 National Welfare Fund for Fishermen (Group Accident Insurance Scheme for Active Fishermen)

Group Accident Insurance Scheme for Active Fishermen	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**Total**
Value (₹ in Lakhs)	4.14	1.91	1.19	2.39	3	Nil***	**12.63**
Number of Beneficiaries	12727	12721	11747	11840	11,840	Nil*	**60875**

Note*Beneficiaries did not apply for scheme**, ** *** Contribution amount not sanctioned by Government **,**
Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

32.5 in 2012-13, ₹ 15 in 2013-14, ₹ 10 in 2014-15, ₹ 20 in 2015-16 and ₹ 25.33 in 2016-17 towards the fund. In 2017-18, the department did not receive any funds from the Central Government.

b) Pradhan Mantri Jeevan Jyoti Bima Yojana (General Insurance Scheme for Active Fishermen): It was started in 2012-13. The insurance premium of ₹ 100/- is paid by the Government and by the Life Insurance Company on 50:50 basis. The details of the amount to be received by the fishermen or nominee are as follows:

On death due to accident	₹ 75,000/- for the nominee.
Permanent/total disability due to accident	₹ 50,000/- to the beneficiary
Partial disability due to accident	₹ 37,500/- to the beneficiary
In the event of natural death of member	₹ 30,000 payable to the nominee

Source: Data of Directorate of Fisheries, Government, Goa.

Table 8.18 shows that the state government has contributed on an average an

Table 8.18 General Insurance Scheme for Active Fishermen

General Insurance Scheme for active fishermen	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Value (₹ in Lakhs)	5.11	5.34	5.73	574	2.25	3.41	**595.84**
Number of Beneficiaries	5110	5338	5735	5733	2247	3406	**27569**

Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

amount of ₹ 100 per year per beneficiary since 2012-13 to 2017-18.

c) Fishermen Corpus Fund for Natural Calamity

Objective: The Corpus Fund was implemented in the year 2013-14 to give financial relief to the fishermen at the time of accidents and natural calamities. Fixed deposit with the nationalized banks is made from the money contributed by the Government and the fishermen (compulsory contribution for five years) and the interest generated is used for relief. The contribution is deducted for five years from the fuel subsidy received by fishermen and added to the corpus fund.

Contribution to be made by Fishermen every year to the Government towards Corpus Fund

Purpose	Contribution (₹)
Person working on the fishing vessel/canoe	₹ 200 per person
Fishing canoe without OBM	₹ 1,000
Fishing canoe with OBM	₹ 2,000
1-4 cylinder fishing vessel	₹ 7,000
6-8 cylinder fishing vessel	₹ 10,000

Source: Data of Directorate of Fisheries, Government, Goa

Table 8.19, reveals that during the year 2014-15, the average amount contributed by the beneficiaries to the government towards the corpus funds is ₹ 2498

Table 8.19 Contribution by Government and Fishermen towards Fishermen Corpus Fund

Corpus fund	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Amount contributed by Government (₹ in Lakhs)	Nil***	298.93	50	250	Nil**	300	**898.93**
Amount contributed by Fishermen (₹ in Lakhs)	Nil***	Nil**	31.07	105.7	Nil**	34.04	**170.81**
Number of Beneficiaries	Nil***	Nil**	1244	2204	Nil**	1244	**4692**

Note: *Beneficiaries did not contribute, ** Amount not contributed by the Government and fishermen, *** Scheme not implemented, **Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Government, Goa.

₹ 4767 in 2015-16,and ₹ 2736 per beneficiary in 2017-18. In 2016-17 amount was not deducted towards corpus fund by the government**.**

d) Relief to Victims under Natural Calamity

Objective: This scheme has been introduced under the Fishermen Corpus fund since 2012-13 to give financial relief to the fishermen.

Eligibility and extent of subsidy: All active fishermen who contribute to the fishermen corpus fund are eligible to avail the financial assistance under this scheme, if their mechanized fishing vessels fitted with the engine motors are damaged or lost due to the natural calamity during the non-ban fishing period from August to May. However, the owner of the fishing vessel should have paid the annual fees prescribed for his crew members, vessels and equipment.

Financial Assistance provided by the Government to the Fishermen

Nature of Implement	Quantum of Financial Assistance
Partial damage of fishing canoe	Actual value assessed by marine surveyor limited to ₹ 1,00,000
Total loss/ damage of canoes with OBM	Actual assessed by marine surveyor limited to ₹ 2,00,000
1-4 cylinder fishing vessel	Actual value assessed by marine surveyor limited to ₹ 7,00,000
6-8 cylinder fishing vessel	Actual value assessed by marine surveyor limited to ₹ 10,00,000
Loss of life/total disability while fishing in sea /river	₹ 5,00,000 in case of loss of life/total disability on construction of necessary documents

Source: Data of Directorate of Fisheries, Government, Goa.

Table 8.19 shows that those fishermen who were victims of the Phyan cyclone which hit the Goan coast in November, 2009, received in installments an average sum of ₹ 37,500 in 2012-2013, ₹ 50,000 in 2013-14, and ₹ 50,000 in 2014-15.

Section 8.3.5 gives the percentage analysis of the various schemes highlighting the details of the disbursal of government schemes to the traditional and mechanized fishing community in Goa.

8.3.5 Analysis of Various Schemes

The percentage contribution of various schemes in the form of subsidies, supplies of material, grant-in-aid and contribution to the extent of total funds released by the government are analyzed in tables 8.20, 8.21, 8.22 and 8.23. Table 8.20 shows

Table 8.20 Disbursement of Government Subsidies for the Fisheries Sector in Goa from 2012-2018 (₹ in lakhs)

Name of the scheme	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Financial assistance on 100% Goa Value Added Tax (VAT) reimbursement on HSD subsidy	1039.87 **(62.71)**	1463.73 **(61.45)**	1499.97 **(57.39)**	1379.92 **(54.85)**	746.64 **(50.99)**	1130.07 **(60.72)**	**7260.20**
Financial assistance for purchase of Fuel (Kerosene/Petrol) for operation of out board motors	499.8 **(30.14)**	576.75 **(24.21)**	469.93 **(17.98)**	500.46 **(19.89)**	539.33 **(36.84)**	537.61 **(28.88)**	**3123.88**
Replacement of old kerosene OBM to petrol OBM	Nil ***	206.65 **(8.68)**	469.93 **(17.98)**	447.69 **(17.79)**	94.10 **(6.43)**	80.22 **(4.31)**	**1298.59**
Construction of wooden / FRP canoe	29.93 **(1.80)**	66.45 **(2.79)**	43.23 **(1.65)**	54.90 **(2.18)**	13.14 **(0.99)**	46.51 **(2.50)**	**254.16**
Tribal sub Plan for Schedule Tribe Development Scheme	22 **(1.33)**	20 **(0.84)**	46.27 **(1.77)**	51.76 **(2.06)**	12 **(0.82)**	12 **(0.64)**	**164.03**
Financial Assistance for purchase of OBM (Motor)	29.93 **(1.80)**	12 **(0.50)**	28.2 **(1.08)**	31.8 **(1.26)**	22.5 **(1.54)**	18 **(0.97)**	**142.43**
Interest Subsidy on loans for Fisheries and allied activities	24.98 **(1.51)**	21.34 **(0.90)**	18.19 **(0.70)**	12.99 **(0.52)**	4.27 **(0.29)**	5.59 **(0.30)**	**87.36**
Financial Assistance to Fishermen for purchase of Fishery Requisites (Gill net)	11.78 **(0.71)**	13.40 **(0.56)**	16.33 **(0.62)**	14.84 **(0.59)**	14.76 **(1.01)**	16.04 **(0.86)**	**87.15**
Financial Assistance for purchase of Power Blocks	Nil***	Nil***	8.73 **(0.33)**	10.92 **(0.43)**	10 **(0.68)**	12.01 **(0.65)**	**41.66**
Financial Assistance to Brackish water Aquaculture Farm	Nil ***	1.71 **(0.07)**	12.94 **(0.49)**	10.73 **(0.42)**	7.42 **(0.50)**	3.21 **(0.17)**	**36.01**
Total amount	**1658.29 (100.00)**	**2382.03 (100.00)**	**2613.71 (100.00)**	**2516.01 (100.00)**	**1464.16 (100.00)**	**1861.26 (100.00)**	**12495.46**

Note: *** denotes Subsidy amount not granted by the Government, Figures in parenthesis denotes percentages, Source: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

that the two most popular subsidies are Goa Value Added Tax on HSD (High speed diesel) and Fuel (Kerosene/Petrol) and these are availed every year by the fishermen.

The subsidies availed for the purchase of power block for purse-seine vessels and for brackish water are unpopular among the fisherfolk. The respondents claim that the money disbursed in case of purse-seine block is only ₹ 150,000 which is relatively less and therefore there were few takers for this scheme. Brackish Water Aquaculture subsidy is also unpopular as very few respondents are involved in this business. Financial Assistance for purchase of OBM has increased over the years. It was highest in 2013-14, as many fishermen owning canoes replaced kerosene motors and purchased new motors. Interest subsidy on loans for fisheries and allied activities where fishermen can avail interest subsidy has decreased over the years, due to lack of awareness of the scheme as well as some fishermen are not interested in obtaining the loan due to burden of payment of interest. This interest subsidy scheme is availed mostly by fishermen owning mechanized vessels.

Table 8.21 depicts that through these schemes, the central government provides financial assistance for the supply of materials like safety equipment, insulated boxes, life jackets and life buoys to the traditional and mechanized sector.

Table 8.21 Cost of Supplies of Material to the Fishermen by the Government from 2012-2018 (₹ in lakhs)

Name of the scheme	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Safety equipment	73.35 **(82.31)**	6.14 **(36.27)**	159.37 **(92.58)**	40.66 **(61.61)**	100 **(86.51)**	Nil***	**379.52**
Supply of insulated boxes to fishermen	7.48 **(8.39)**	9.8 **(57.89)**	4.96 **(2.88)**	16.89 **(25.59)**	13.83 **(11.96)**	9.73 **(100)**	**62.69**
Supply of jackets and life buoys	8.28 **(9.29)**	0.99 **(5.85)**	7.82 **(4.54)**	8.45 **(12.80)**	1.77 **(1.53)**	Nil***	**27.31**
Total amount	**89.11**	**16.93**	**172.15**	**66**	**115.6**	**9.73**	**469.52**

Note: *** denotes Subsidy amount not granted by the Government, Figures in parenthesis denotes percentages,
Source: Compiled by Researcher from data of Fisheries Dept and Demand Book, Govt. of Goa.

Even though the fisher folk get these things free of cost, they are not satisfied with the supplies. The main reason for this is that the materials supplied are of low quality.

Table 8.22 shows that the National Welfare Fund for Fishermen (Saving Cum Relief fund) which is categorized under the Grant-in-aid is the most popular scheme among fishermen, as they are supported financially during the lean seasons. Financial assistance to the registered fishermen co-operative societies and associations are unpopular schemes as the amount provided by the Government to run the society is meager. The management of the societies opined that money is disbursed after burdensome documentation. Hence, the fishermen co-operative societies and associations arrange their own finance from members and run the society. National

Welfare Fund for Development of Fishermen Village Housing has been availed by many schedule tribe fishermen for the construction of houses but there are also

Table 8.22 Grant- in- Aid by the Government for the Fisheries Sector from 2012-2018 (₹ in lakhs)

Name of the scheme	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Saving Cum Relief fund	66.06 **(97.78)**	73.2 **(94.51)**	102.73 **(96.71)**	93.55 **(98.68)**	97.48 **(89.04)**	97.48 **(98.24)**	**530.5**
Financial Assistance to Registered Fishermen Association and Co-operative Societies	Nil ***	3.5 **(4.52)**	2 **(1.88)**	0.5 **(0.53)**	8 **(7.31)**	1 **(1.01)**	**15**
National welfare fund for development of fishermen village housing	1.5 **(2.22)**	0.75 **(0.97)**	1.5 **(1.41)**	0.75 **(0.79)**	4 **(3.65)**	0.75 **(0.76)**	**9.25**
Total Amount	**75.06 (100)**	**41.44 (100)**	**106.73 (100)**	**94.8 (100)**	**109.48 (100)**	**99.23 (100)**	**554.75**

Note: *** denotes Subsidy amount not granted by the Government, Figures in parenthesis denotes percentages, **Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

complains on the delay in payment and the quantum of subsidy given by the government which is inadequate.

Table 8.23 gives the analysis of the contribution towards schemes by the Government for the fishing industry. Out of the four schemes listed in table 8.23, corpus fund scheme is working with the combined contribution of the government and the individual fisherman. All other contributions are fully financed by the Central and State Government. The fishermen are unhappy with some of the schemes mentioned. They are unhappy with corpus fund as deductions are made from their eligible VAT

Table 8.23 Contribution towards Schemes by the Government for the Fisheries Sector from 2012-2018 (₹ in lakhs)

Name of the scheme	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total
Govt. contribution towards corpus fund	Nil ***	298.93 **(97.00)**	50 **(87.08)**	250 **(30.25)**	Nil***	300 **(98.88)**	**898.93**
General Insurance scheme for active fishermen	5.11 **(30.51)**	5.34 **(1.73)**	5.73 **(9.98)**	574 **(69.46)**	2.25 **(42.86)**	3.41 **(1.12)**	**595.84**
Group Accident Insurance Scheme for Active Fishermen	4.14 **(24.72)**	1.91 **(0.62)**	1.19 **(2.07)**	2.39 **(0.29)**	3 **(57.14)**	Nil	**12.63**
Relief for Phyan Cyclone victims	7.5 **(44.78)**	2 **(0.65)**	0.5 **(0.87)**	Nil	Nil	Nil	**10**
Total Amount	**16.75**	**308.18**	**57.42**	**826.39**	**5.25**	**303.41**	**1504.77**

Note: *** denotes Subsidy amount not granted by the Government, Figures in parenthesis denotes percentages, **Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa.

diesel and fuel subsidy. In the other cases, the claim of financial assistance can be made in case of only untoward incidents. The respondents stated that the burdensome documentation and the procedures of the Fisheries Department discourage them from availing the schemes. However, certain schemes are not availed by many fishermen in Goa, due to lack of time as the traditional fishermen are personally involved in fishing operations, and as such have no time to comply with the government formalities, paper work and documentation. Some of the schemes are not disbursed on time due to the paucity and availability of the funds by the government.

Section 8.3.6 depicts the compound annual growth rate of the schemes.

8.3.6 Compound Annual Growth Rate (CAGR) of Fisheries Schemes

Table 8.24 shows the compound annual growth rate of the subsidies, grant in aid, contribution and total supplies disbursed by the Government from 1990 to 2018 in Goa. The total CAGR of subsidies, total supplies, grant-in-aid and contribution is given in table 8.24 shows a fluctuating trend over the years. In case of contribution, and total supplies the schemes were started after 2005. In the case of total CAGR also there is a fluctuating trend. The total and average expenditure by the Government on the schemes has been increasing over the years. However, it can be seen that the

Table 8.24 Compound Annual Growth Rate of Subsidies, Grant-in-aid, Contribution and Total Supplies from 1990 to 2018 (₹ in lakhs)

Periods	Subsidies (%)	Grant - in- Aid (%)	Contribution (%)	Total Supplies (%)	Total CAGR of the schemes (%)	Total spending by the Govt. on schemes (₹ in lakhs)	Average spending by the Govt. on schemes (₹ in lakhs)
1990-1995	58.78	(-) 61.29	Nil	Nil	(-) 59.34	149.02	29.8
1995-2000	249.91	119.23	Nil	Nil	272.47	355.25	71.05
2000-2005	24.51	3.84	Nil	114.85	20.03	315.46	63.09
2005-2010	(-) 3.79	13.63	107.79	(-) 0.17	(-) 2.46	5215.57	1043.11
2010-2018	35.62	(-) 5.58	125.60	(-) 31.59	23.85	16685.94	2085.74
Ful1 period 1990-2018	**16.34**	**8.95**	**42.75**	**12.58**	**16.03**	**22721.24**	**811.47**

Note: Total CAGR represents the sum of CAGR of subsidies, Grant-in-aid, contribution, and supplies. Total spending represents total amount spent by state and central government towards subsidies, grant in aid, contribution and supplies, **Source**: Compiled by researcher from the data analysis of the data from Demand book, Government of Goa.

overall CAGR of the schemes is not showing an increasing trend as there are no takers for some of the schemes of the Government. The contribution and total supplies schemes were implemented since 2004-05.

Section 8.3.7 shows the per capita benefit of the schemes, namely; subsidies, supplies of material, grant-in-aid and contribution.

8.3.7 Per capita Benefit of the Schemes

Table 8.25 shows the comparison of subsidies, supplies, grant-in-aid and contribution given by the government to the fishing industry in Goa. The percentage of subsidy to the total fishing Gross State Domestic Product (GSDP) is calculated to know the extent of expenditure by the government to support the fishing industry in Goa. The calculation of total subsidy to total fishing GSDP is done based on the model formula given in equation 8.1 and the same is repeated for all the four schemes of financial assistance. The per capita subsidy is calculated based on the model formula given in equation 8.2 and the same has been used for all the schemes.

$$\textbf{Total Subsidy to Fishing GSDP} = \frac{\textbf{Total amount of expenditure by Govt. towards subsidy}}{\textbf{Total Fishing GSDP}} \textbf{ X 100…(Eqn. 8.1)}$$

$$\textbf{Per capita subsidy} = \frac{\textbf{Total amount of expenditure by Govt. towards subsidy (₹ in Lakhs)}}{\textbf{Number of Beneficiaries}} \textbf{……………(Eqn.8.2)}$$

Table 8.25 indicates that the GSDP of fisheries sector of Goa has shown variation over the years from 2012-2017. The amount spent by the Government on subsidies has shown variation over the years and a severe dip was evident during 2016-17. The comparison of the percentage of government expenditure in form of total subsidy to total fishing GSDP towards the fisheries sector indicates a variation in the trend and it was highest during 2014-15. There is marginal increase in the expenditure on subsidies in proportion to the increase in the fishing GSDP of the state. The per capita subsidy depicts an increasing trend from 2012-18. The Central Government support towards the supplies of materials is highest during 2014-15 but is very less during 2017-18. The percentage of finance for supply of materials by the government to the fishing GSDP is highest during 2014-15. The per capita supply of materials also show variation, but is highest in 2016-17 due to schemes of Blue revolution. The grant-in-aid has been highest in 2016-17. The percentage of grant-in-aid to total fishing GSDP has shown variation from 2012-17. The per capita grant-in-aid also shows considerable variation from 2012-18, but was highest in 2016-17. The reason being in 2016-17, ever since the Central Government allotted more funds under the Blue Revolution scheme it caused allocation of more funds to the states.

Table 8.25 Percentage of Grants by Governments towards Fisheries Subsidies to the Total GSDP from 2012-2018 (GSDP at factor cost at constant prices 2004-05)

Particulars	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Subsidies						
Total Fishing GSDP **(₹ in lakhs)**	**32606**	**22873**	**22520**	**27901**	**30543**	**NA**
Total Amount of expenditure by Govt. towards subsidy to fishermen **(₹ in lakhs)**	1658.29	2382.03	2613.71	2516.01	1464.16	1861.26
Total subsidy to Total Fishing GSDP **(Percentage)**	5.09	10.41	11.61	9.02	4.79	NA
Per capita subsidy **(in₹)**	86640	97825	97454	96881	111513	130798
Supplies of Materials						
Total Supplies of material to fishermen **(₹ in lakhs)**	89.11	16.93	172.15	66	115.6	9.73
Total supplies of material to total fishing GSDP **(Percentage)**	0.27	0.07	0.76	0.24	0.38	NA
Per capita supplies **(in ₹)**	28110	2645	22299	6426	31671	16492
Grant -in –Aid						
Grant in aid **(₹ in lakhs)**	75.06	41.44	106.73	94.8	109.48	99.23
Total Grant in Aid to total Fishing GSDP **(Percentage)**	0.23	0.18	0.47	0.34	0.36	NA
Per capita Grant-in-Aid **(in ₹)**	1425	706	1867	1823	2021	1831
Contribution						
Total contribution by Govt. **(₹ in lakhs)**	16.75	308.18	57.42	826.39	5.25	303.41
Total Contribution to Total Fishing GSDP **(Percentage)**	0.05	1.35	0.25	2.96	0.02	NA
Per capita contribution **(in ₹)**	94	1706	307	4179	37	6525

Note: Fishing GSDP of Goa for till 2015-16 is Actual, GSDP for 2016-17 is Provisional, NA means data not available, **Source**: Compiled by researcher from the data analysis of the data from Directorate of Fisheries, Govt, Goa and various issues of Goa Economic Survey of Goa, Statistical Handbook of Goa.

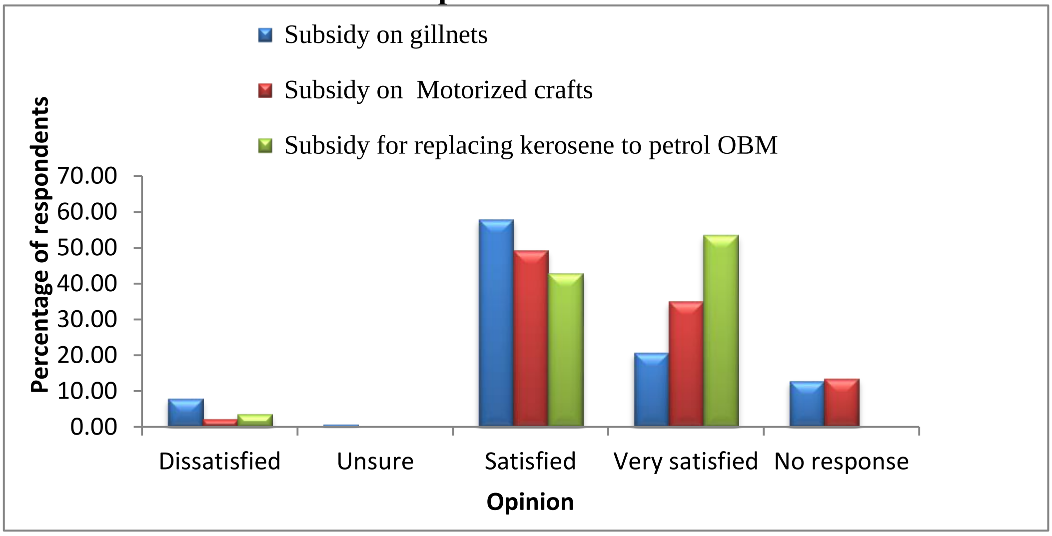
The contribution by the government as well as the percentage to the fishing GSDP has shown variation from 2012-17, however, the amount of contribution is substantial during 2015-16 due to the funds allotted under the Blue revolution scheme. The per capita contribution is highest during 2017-18.

Section 8.3.8 discusses the satisfaction level of the fishermen owning motorized canoes towards subsidies availed by them.

8.3.8 Subsidies to the Fishermen owning Motorized Canoes

The Government provides subsidy for gill nets, purchase of motorized canoes, and for replacement of kerosene motor to petrol motor only to the fishermen owning canoes. Figure 8.3 shows that majority of the respondents are happy and satisfied with all the three subsidies. Among all the three subsidies, the highest amount received by the fishermen is to replace the kerosene motor with petrol motor which is ₹ 90,000 per respondent. In case of gill net the subsidy received is ₹ 30,000 and for fishing canoe it is ₹ 60,000. There were some respondents who were dissatisfied and those who did not avail the subsidy did not respond. The interviews with these respondents indicated that they are not keen in availing such subsidies, mainly because many of them did not have the relevant documents related to their business which is required

Figure 8.3 Satisfaction level of Fishermen on Subsidies Availed on Gill nets, Motorized Crafts and Replacement of Kerosene to Petrol OBM



Source: Researchers compilation from primary survey.

to avail the subsidy. The percolation of government money to the traditional fisheries sector, hence needs severe monitoring to ensure that the money reaches the deserving hands on time.

The next section 8.3.9 presents the analysis of the impact of fuel subsidy on the fishing business of the traditional and mechanised sector.

8.3.9 Impact of Fuel subsidy on Fishing Business

Fuel is the major component of operating cost for the three groups of fishing crafts, namely; motorized canoes, trawlers and purse-seine vessels. In table 8.26, a comparison is done to study the impact of fuel subsidy on the expenditure incurred by fishermen on the cost of fuel on motorized canoes and mechanized vessels. The Government of Goa provides fuel subsidy to the motorized crafts and 100% VAT reimbursement on fuel to the mechanized vessels. This government support helps the fishermen to reduce the cost of fishing operations to some extent due to the exorbitant increase in the price of fuel over the years. This study finds that the larger the fishing craft, and longer the distance travelled, more the fuel consumption and relative amount of subsidy is provided by the government. Hence, the average fuel subsidies as well average fuel cost are directly proportional to the size of the fishing crafts. Table 8.26 reveals that among the motorized canoes, fishermen with smaller canoes

Table 8.26 Impact of Fuel Subsidy on the Fuel Cost incurred by the Fishermen Owning Motorized Canoes and Mechanized Vessels

Particulars	Motorized Canoes		Mechanized Trawlers			Mechanized Purse-seiners	
Size in feet	**26-30 ft**	**31-38 ft**	**32-36ft**	**38-45 ft**	**46-60 ft**	**46-60 ft**	**61-75 ft**
Classification	**8HP**	**9.9 HP**	**Small**	**Medium**	**Large**	**Medium**	**Large**
Average Fuel Subsidy **(in ₹)**	44296	44399	120828	176343	200430	209183	226711
Average Fuel Cost **(in ₹)**	156571	267916	913243	1251464	1509374	2398231	3124797
Percentage of Average Fuel subsidy to Fuel Cost	**(29.13)**	**(17.7)**	**(14.34)**	**(17)**	**(15.66)**	**(9.65)**	**(7.73)**

Note: HP means horsepower of the fishing craft**, Source:** Researchers compilation from data analysis of primary Survey, Figures in parenthesis represents percentages.

with (8 HP) are getting a higher percentage of fuel subsidy as compared to the (9.9 HP) canoes. Among the trawlers, fishermen owning medium vessels get a higher percentage of fuel subsidy to the fuel costs as compared to small and large trawlers. The results in table 8.26 also shows that among all the three groups, the highest average amount on fuel is spent by the fishermen owning purse-seine vessels, but the percentage of average fuel subsidy received from government to the cost of fuel is the lowest. However, majority of the fishermen owning motorized canoes in the study area are of the opinion that fuel subsidy helps them to reduce their cost of fishing operations, and increase the number of fishing trips which eventually helps them to a certain extent to increase their fish catch. But the trawler and purse-seine owners strongly opined that VAT diesel reimbursement subsidy is meager when compared to the amount they spend on cost of fuel.

The next section 8.3.9.1 presents the analysis of the impact of fuel subsidies on the satisfaction level of fishermen.

8.3.9.1 Impact of Fuel Subsidies on the Satisfaction of Fishermen

In order to study whether the satisfaction level of the fishermen is dependent on the fuel subsidies they receive from the government, the statistical tools namely; fishers exact and chi-square tests are used. The null hypothesis proposed is that "*There is no impact of fuel subsidies on the* satisfaction level *of fishermen".*

It is evident from table 8.27 that overall satisfaction of the fishermen is significantly associated with the fuel subsidy which helps them to increase the fishing

Table 8.27 Results of Fishers exact test and Chi-square tests Regarding the Impact of Fuel Subsidies on the Satisfaction Level of Fishermen

Null hypotheses for subsidies on fuel	d.f	Test value	*p* value	Decision
Fuel subsidy does not help to increase fishing days	4	FETV=13.350	0.008**	Reject
Fuel subsidy does not help to increase fishing operations and improve fish catch	4	CSTV=6.748	0.152	Accept
Fuel subsidy does not help to reduce cost of fishing operations	4	FETV=10.336	0.034*	Reject

Note: FETV- Fishers Exact Test Value , CSTV- Chi-square Test Value** -Significant at 1% level of significance * -Significant at 5% level of significance, **Source:** Data analysis from primary survey.

days and also to reduce the cost of fishing operations. The null hypothesis is rejected at 1% and 5% level of significance. This leads to the conclusion that satisfaction level of the fishermen is dependent on the fuel subsidy they receive which helps them to increase the fishing days and eventually to reduce cost of fishing operations. However, the fuel subsidy does not help them to increase the fishing operations in order to improve the fish catch.

Section 8.3.10, presents the analysis of the satisfaction level of the fishermen regarding the supplies of material and fuel subsidy availed from the government in carrying out their fishing business.

8.3.10 Satisfaction level of Fishermen on Supplies of Material and Subsidy

The chi-square and fisher's exact test are used in table 8.28 to study the satisfaction level of fishermen regarding the supplies of material and subsidy received from the government. The null hypothesis proposed is that "*There is no impact of supplies of material and fuel subsidies on the* satisfaction level *of fishermen".*

Table 8.28 Results of Fishers exact test and Chi-square tests Regarding the Supplies of Material and Subsidies on the Satisfaction level of Fishermen

Null hypotheses for supplies of material and subsidies	d.f	Test value	*p* value	Decision
Supply of safety jackets and lifebuoys have no impact on satisfaction level of fishermen	4	FETV=36.089	0.000**	Reject
Supply of insulated boxes have no impact on satisfaction level of fishermen	3	CSTV=3.211	0.073	Accept
Supply of equipment such as GPS, VHF& rescue beacon have no impact on satisfaction level of fishermen	3	CSTV=19.099	0.000**	Reject
Reimbursement of VAT on diesel and fuel subsidy have no impact on satisfaction level of fishermen	4	FETV=10.399	0.000**	Reject

Note: FETV- Fishers Exact Test Value, CSTV- Chi-square Test Value, ** -Significant at 1% level of significance, **Source:** Researches compilation from the data analysis from the primary survey.

From the analysis of results in table 8.28, it is evident that the satisfaction level of the fishermen is significantly dependent on the supplies of material and subsidies they receive for their fishing business, at 1% level of significance as $p < 0.01$ for each of the selected variables except for supply of insulated boxes to fishermen. This leads to the conclusion that the supplies of material such as safety jackets, lifebuoys and equipment, as well as reimbursement of VAT on diesel and fuel subsidy have significant impact on the overall satisfaction level of the fishermen. The subsidy on the supply of insulated boxes received by fishermen has no impact on the satisfaction of the fishermen. The reason is because the insulated boxes cost only a nominal amount as explained in table 8.11.

Section 8.3.11 presents the analysis of the satisfaction level of the fishermen engaged in mechanized fishing business as regards facilities offered by the fisheries co-operative societies at various fishing jetties.

8.3.11 Satisfaction on the Facilities offered by Fisheries Co-operative Societies

The fisheries co-operative societies provide various facilities to the fishermen operating their trawlers and purse-seine vessels at the Malim, Chapora, Vasco and Cutbona jetties. However, all the facilities are not uniformly available across all the jetties. The proposed hypothesis is that, "*There is no significant difference in the mean ranking by the fishermen as regards facilities availed by them from fisheries co-operative societies across the jetties*". The mean ranking given by the fishermen is used to analyze the facilities which are available and those which are lacking at the respective jetties.

The preference of mean ranking given by the fishermen towards the facilities availed is given in table 8.29. The statistical tool Friedman's test calculated chi-square value is 239.824. The significance value for 09 degrees of freedom is 0.000 which is less than 0.01. Hence, it is inferred that there is significant difference in the mean ranking between the variables. It is observed that compared with other indicators, fishermen have given highest ranking for supply of diesel at jetties with mean rank 7.14 and it is a very significant factor. Awareness of government schemes with mean rank of 6.99, credit facility for supply of diesel is mean ranked at 6.25 and availability of water facilities for fishing vessels at the jetties with mean rank of 5.58 are *the* next significant factors which have contributed towards the satisfaction of the fishermen as far as facilities availed from cooperative societies are concerned. The least ranked factor is availability of adequate space for berthing of vessels at the jetties. The most

Table 8.29 Mean Ranking by Fishermen for the Facilities Availed from Fisheries Co-operative Societies

Facilities availed from cooperative societies at the jetties by Trawler and Purse-seine owners	Mean Rank	Rank	Friedman's test value
Supply of Diesel	7.14	1	239.824, d.f=09, p value=0.000<0.01
Awareness of government schemes	6.99	2	
Credit facility available for supply of diesel	6.25	3	
Availability of water facilities for vessels	5.58	4	
Fish selling outlets at jetty	5.56	5	
Supply of LPG, grocery and consumer goods on wholesale basis	5.54	6	
Availability of fisheries requisites and spare parts	5.16	7	
Repairs of boats and nets	4.73	8	
Availability of ice plant and cold storage facilities	4.20	9	
Availability of adequate space for landing of vessels	3.84	10	

Source: Researches compilation from the data analysis from the primary survey.

influencing indicators compared with other significant indicators are tested with Friedman test. Since asymptotic significance is less than 0.01 (1% level of significance), the null hypothesis is rejected. The hypothesis that there is significant difference in the mean ranking for the satisfaction level of fishermen due to facilities availed from cooperative societies is tenable.

Most of the respondents are satisfied with the supply of diesel facilities by the fisheries co-operative societies at the jetties**.** However, respondents at Malim jetty expressed the need for one more diesel pump. The Fisheries Department of Goa issues notifications regarding the changes in rules, regulations, announcement of new schemes to the fisheries co-operative societies, and the societies in turn communicate the same through notices and meetings to the fishermen. The respondents claim that this is a great help to them as they are well informed and aware about the amendments in schemes and other regulations regarding their fishing business. The staff in the fisheries co-operative societies also helps the fishermen in the documentation process as well as other procedures to be followed in availing of the government schemes for fishing business.

The Independent sample *t* test is used to analyze whether there is a significant difference in the satisfaction level of fishermen as regards facilities availed by them from co-operative societies among the two districts. The null hypothesis stated is, that, "*There is no significant difference in the satisfaction level of the fishermen* *owning mechanised vessels in North Goa and South Goa regarding the facilities availed by them from fisheries cooperative societies*".

The results of Independent sample *t* test in table 8.30 indicates that there is a significant difference in the satisfaction level of fishermen as regards facilities availed from the cooperative societies in North and South Goa. The variables which have significant differences are, "Availability of adequate space for landing of vessels", at 1% level of significance, $p<0.01$. "Availability of ice plant at jetties" and "Fish selling outlet at jetties" are significant at 5% level of significance, as the $p<0.05$ for both the variables. But for the rest of the variables there is no significant difference between them. The descriptive analysis indicates that fishermen from South Goa especially from Cutbona jetty are satisfied with availability of adequate space for landing of vessels as compared to fishermen from North Goa. However, fishermen from Vasco in South Goa, Malim and Chapora in North Goa are dissatisfied as these jetties are too small to accommodate vessels, thereby increasing cost of maintenance of vessels.

Table 8.30 Results of Independent Sample *t* test Regarding Facilities Received by Fishermen Owning Mechanised Vessels from Fisheries Co-operative Societies

Facilities received by fishermen from fishermen cooperative societies at jetties	Mean North Goa	Mean South Goa	*t*- test value	*p* -value	Decision
Availability of adequate space for landing of vessels	3.51	4.04	3.52	0.001**	Reject
Availability of ice plant and cold storage facilities	4.73	4.54	-2.07	0.041*	Reject
Supply of diesel	4.63	4.73	1.23	0.22	Accept
Awareness of government schemes	4.39	4.54	1.60	0.11	Accept
Credit facility for diesel	4.30	4.33	-0.28	0.776	Accept
Availability of water facilities	4.26	4.36	-0.84	0.398	Accept
Fish selling outlets	3.94	3.56	2.22	0.028*	Reject
Supply of LPG, grocery and consumer goods on wholesale basis	4.26	4.23	0.30	0.765	Accept
Availability of fishing requisites and spare parts	4.09	4.23	1.61	0.108	Accept
Repairs of fishing boats and nets	4.35	4.37	-0.26	0.792	Accept

Note: ** Variable significant at 1%, * variable significant at 5%, level of significance, **Source:** Researchers compilation from the data analysis from the primary survey.

Fish is a perishable commodity and requires proper storage facilities to avoid decomposition. The satisfaction level of fishermen regarding availability of ice plants is higher in North as compared to South Goa. This is because there is only one ice plant at Malim jetty. Amongst the four jetties, Vasco and Chapora have no ice plants and as such the respondents have to depend on distant ice plants. The fishermen expect the availability of ice in the vicinity of the jetties at a lower price at their convenience which will save the cost on ice. However, if the ice has to be brought from far off places it results in loss to them due to melting of the ice. The respondents at Malim and Cutbona jetties were satisfied with the ice plants but they suggested that one ice plant is insufficient for the number of vessels operating on them. The fisherfolk expect that the government should set up more ice plants on these jetties, supplying ice at reasonable rates. The respondents are dissatisfied as there are no ice plants at Vasco and Chapora jetties. Hence, urgent measures need to be taken up by the government to set up new ice plants. The respondents from Malim and Chapora jetties are satisfied with the facility of fish outlets as compared to fishermen from South Goa. However, there are no fish outlets at Cutbona and Vasco jetties. The government has to initiate steps in setting up fish outlets at these jetties.

Section 8.3.12 presents the analysis of the satisfaction level of the fishermen on the basis of economic and social factors.

8.3.12 Satisfaction over Fishing as a Business

On the basis of the economic and social factors, the researcher investigated the satisfaction level of the fishermen with their fishing occupation. The null hypothesis stated is that, "*There is no significant difference for the mean ranking of the satisfaction level by the fishermen regarding economic and social factors affecting fishing business*". Table 8.31 presents the results of mean ranking of satisfaction of

Table 8.31 Satisfaction level of Fishermen on the Basis of Social and Economic Factors over Fishing Business

Type of Fishing Crafts	Canoes		Trawlers		Purse-seiners	
Satisfaction level in fishing business	**Mean Rank**	**Rank**	**Mean Rank**	**Rank**	**Mean Rank**	**Rank**
Economic factors						
It is a source of livelihood and provides direct and indirect employment	3.79	1	3.62	1	3.56	1
Fishing is a profitable venture provided they get good catch and favourable price	2.52	4	2.62	4	2.56	4
Social factors						
It has helped to improve the socio-economic condition of fishermen	3.11	3	3.46	2	3.25	3
Happy to continue with the ancestral fishing business	3.50	2	3.23	3	3.33	2
Future generation to continue the fishing business	2.08	5	2.07	5	2.30	5
Friedman's test value	150.60, d.f=4, p-value=0.000<0.01		70.18, d.f=4, p-value=0.000<0.01		49.59,d.f=4, p -value=0.000<0.01	

Source: Researches compilation from the data analysis from the primary survey.

fishermen towards the social and economic factors affecting the fishing business. The results indicate that the Friedman's chi-square value is 150.60 for fishermen owning canoes, 70.18 for trawlers and 49.59 for purse-seiners. The significance value for 4 degrees of freedom is 0.000 which is less than 0.01 for satisfaction level of fishermen owning canoes, trawlers and purse-seiners. Hence, it is inferred that there is a significant difference in the mean ranking between the variables for all fishermen. All the fishermen have given the highest mean ranking for the variable, "Fishing business as a source of livelihood providing direct and indirect employment" and it is considered as a very significant economic factor which has an impact on the satisfaction level of fishermen. Least ranking is given by the fishermen for the social factor, "Future generation to continue the present fishing business", as fishermen were not sure whether children would continue their fishing business in future. Some fishermen stated that their children were not interested in continuing the fishing business in future.

The Independent sample *t* test is used to compare whether there is a significant difference in the satisfaction level of fishermen with the fishing business in North and South Goa. The null hypothesis stated is that, "*There is no significant difference in the satisfaction level of fishermen on the economic and social factors in the fishing business in North and South Goa*". The results of Independent sample *t* test given in table 8.32 indicates that there is a significant difference in the satisfaction level of the

Table 8.32 Satisfaction level of Fishermen on the Fishing Business

Satisfaction of fishermen	Mean North Goa	Mean South Goa	*t*- test	*p* value	Decision
Economic factors					
It is a source of livelihood and provides direct and indirect employment	4.44	4.64	-2.90	0.004**	Reject
Fishing is a profitable venture provided they get good catch and favourable price	3.78	3.94	-1.60	0.11	Accept
Social factors					
It has helped to improve the socio-economic condition of fishermen	4.22	4.39	-1.95	0.052	Accept
Happy to continue ancestral fishing business	4.20	4.46	-2.48	0.011*	Reject
Future generation to continue fishing business	3.38	3.54	-0.99	0.322	Accept

Note: ** Variable significant at 1%, * variable significant at 5%, level of significance **Source:** Researchers compilation from the data analysis from the primary survey.

fishermen of North and South Goa. The factors which are significant are "Source of livelihood" at 1% level of significance, $p<0.01$ and "Happy to continue ancestral traditional business" at 5% level of significance, $p<0.05$. However, there exists no significant difference in the satisfaction level among the fishermen in both the districts for other factors, such as "Fishing improves socio-economic condition", "Fishing is profitable venture due to favourable price factor" and "Future generation to continue fishing business" are concerned. But as far as economic factor such as "Fishing as source of livelihood" and social factor "Happy to continue ancestral fishing business" are concerned, fishermen from South Goa are more satisfied on an average then fisherman from North Goa. Majority of the respondents are satisfied with their fishing occupation as it provides livelihood and employment to them as well as others. Even though it is a tedious and risky occupation, fishermen still would like to continue in fishing business as it is their main source of livelihood.

The next section 8.3.13 discusses about the problems faced by the fishermen.

8.3.13 Problems Faced by the Fishermen

This study also attempts to examine the problems faced by the fishermen owning motorized canoes and mechanized vessels in Goa. The Friedman's test is used to mean rank the problems faced by the fishermen. It is also used to find out whether there is significant difference in the mean ranking for the problems encountered by the respondents. The null hypothesis proposed is that, "*There is no significant difference in the mean ranking for the problems faced by the fishermen in fishing business".* The result of Friedman's test shown in table 8.33 indicates that the chi

Table 8.33 Mean Ranking for Problems Faced by Fishermen

Problems faced by fishermen in fishing business	Mean rank	Rank	Friedman's test value
Damage to hull, and fishing equipment	7.81	1	255.717, d.f=10, *p* value= 0.000<0.01
Problems due to illegal fishing such as mini-purse-seining, high speed boats, bull trawling , and led lights	7.33	2	
Cost of fishing per trip has increased	6.26	3	
Inadequate Infrastructure such as berthing of vessels and lack of cold storage facilities	6.01	4	
Reduced fish catch due to excess fishing efforts and overexploitation resulting in low profits	5.93	5	
Illegal fishing by high speed boats, bull trawling and LED fishing by neighbouring states	5.74	6	
Problems due to unavailability of labour	5.68	7	
Middlemen agents take major share of profit at the cost of fishermen	5.55	8	
Problems in repayment of loans due to less fish catch	5.45	9	
Increase in size of mechanized vessels leading to competition for fishing	5.25	10	
Agents from other states sell frozen fish in the market which affects the business of local fishermen	4.99	11	

Source: Researchers compilation from the data analysis from the primary survey.

square value is 255.717. The significance value for 10 degrees of freedom is 0.000 which is less than 0.01. Hence, it is inferred that there is significant difference in the mean ranking between the variables. The results also indicate that, among all the indicators, the problem related to "Damage to equipment" with mean rank 7.81 is the most significant factor, followed by "Problems due to illegal fishing by way of high speed boats, bull trawling and led lights" with mean rank 7.33, "Costs of fishing per trip has increased" *with mean rank 6.26 and "*Inadequate infrastructure facility" *with mean rank 6.01* are the other significant problems faced by the fishermen. The most influencing indicators compared with other significant indicators are tested with Friedman test. Since the $p<0.01$ at (1% level of significance), the hypothesis is rejected justifying that there is significant difference in the mean ranking for the problems faced by fishermen in fishing business.

The Independent sample *t* test is conducted to compare whether there is a significant difference as regards the problems faced by fishermen in both the districts. The null hypothesis proposed is that, "*There is no significant difference in the problems faced by the fishermen between the two districts i.e North and South Goa*".

In the table 8.34, it is evident that there exists no significant difference in the problems faced by the fishermen of North and South Goa except the problems of

Table 8.34 Results of Independent Sample *t* test for Problems Faced by Fishermen in Fishing Business

Problems faced by fishermen	North Goa Mean	South Goa Mean	*t*- test	*p* value	Decision
Damage to hull, and fishing equipment	4.65	4.72	1.18	0.23	Accept
Problems due to illegal fishing such as mini-purse-seining, high speed boats, bull trawling, and led lights	4.64	4.53	1.59	0.11	Accept
Cost of fishing per trip has increased	4.36	4.36	-0.02	0.98	Accept
Inadequate infrastructure such as berthing of vessels and lack of cold storage facilities	4.06	4.30	2.12	0.03*	Reject
Reduced catch due to excess fishing efforts and overexploitation	4.30	4.18	1.5	0.13	Accept
Illegal fishing by high speed boats, bull trawling and LED fishing by neighbouring states	4.08	4.25	-2.02	0.04*	Reject
Problems due to unavailability of labour	3.69	3.83	-0.76	0.44	Accept
Middlemen take major share of profit at the cost of fishermen	4.01	4.15	-1.44	0.14	Accept
Problems in repayment of loans due to less fish catch	4.06	4.19	-1.83	0.06	Accept

Note: *Variable significant at 5% level of significance, **Source:** Researchers compilation from the data analysis from the primary survey.

inadequate space for berthing fishing crafts and lack of cold storage facility as well as illegal fishing by neighbouring states, at 5% level of significance, as $p<0.05$ for these two variables. The fishermen from both the districts are facing the same problems such as damage to equipment, illegal fishing due to bull trawling and led lights, increased cost of fishing, problems in repayment of loan, reduced fish catch due to excess fishing efforts resulting in low profits, problems due to unavailability of labour, and middlemen getting the major profit at the cost of fishermen. But as far as inadequate infrastructure such as berthing of vessels and illegal fishing by mechanised vessels of neighbouring states are concerned, fishermen from South Goa face highest problems on an average as compared to North Goa.

There are also other problems fishermen face in the study area, such as unfavourable weather conditions, which has an adverse effect on the fishing trips. The fishermen also state that the water sports boats used for tourism purpose, high speed boats, dolphins in the sea and rocks frequently destroy the fishing nets of fishermen. The replacement of nets is frequent and every year it increases the capital cost for the fishermen. The fishermen incur huge expenditure on fishing gears, other equipment and towards its repair and maintenance. Fishermen also narrated that fish catch has depleted over the years due to illegal fishing viz. operation of high speed boats, bull trawling, LED purse-seine fishing, even though these illegal methods are being banned by the Fisheries Department in Goa. The Government has prohibited fishing by high speed mechanised boats with 450 horsepower engines but the mechanised vessels from neighbouring states enter Goa’s waters and sweep away the fish catch depriving the local fishermen of good catch. This is because governments monitoring and surveillance system has failed to monitor illegal fishing activities.

The fishermen also face problems in the repayment of loans due to reduced fish catch. The price of fuel has escalated manifold over the years as compared to the increase in the price of fish. In some coastal villages, there are no fishing ramps and some ramps built by the government are non-operational. Fishermen do not have the facility to store their fish catch near the landing centers in order to get a fair price. Another difficulty faced by the respondents is unavailability of cold storage facilities for preservation of fish across all the jetties in Goa, due to which fishermen have to sell immediately their fish catch even at lower prices to the agents. Due to this the agents earn more profit than the local fishermen. The perishable material is sold as quickly as possible to the middlemen agents at the landing centre or even in the wholesale and retail markets. These middlemen decide the price and the fishermen are forced to sell their catch below the actual market price, hence the fishermen are at the losing end. Huge finance is required for the fishermen to adapt to the technological changes in fishing. Majority of the fishermen owning motorized canoes, small and medium trawlers are reluctant to invest in installing modern gadgets. They cannot afford to use the modern communication facilities and technology equipment due to the high capital investment. The motorised canoe owners are marginalised due to lack of capital and cannot compete with the fishermen owning large trawlers and purse-seine vessels.

The other miscellaneous problems encountered by the fishermen are the tourism developmental activities, disposal of waste, sewage, pollution (oil spill) and miscellaneous factors that has affected the coastal system affecting the productivity of marine fisheries resources. It is reported that introduction of technologically advanced vessels like trawlers and purse-seiners which cause marine pollution through oil spills have destroyed the breeding grounds of fish. Most of the labourers employed are migrants and hence labour availability is a problem for the respondents. There are liquor bars situated closer to the jetties further aggravating the problem resulting in labour turnover and alcoholism. Fishing is a risky occupation involving dangers due to natural calamities as well as financial loss. Besides, there is also a risk to life, and uncertainty of the financial returns from the business. So also the fishermen face several other problems that hinder their business. There are unending problems in this sector, but still the fisher folk are undertaking fishing as their livelihood and thus help in nation building. Government can initiate measure to provide the infrastructure facilities across all the landing centres to help the fishermen to carry out their fishing activities smoothly.

8.4 Summary

The study has offered insights about the financial and physical achievement of various schemes provided by the government to support the fishing industry. The maximum expenditure incurred by the government is on the top two popular subsidies namely, VAT diesel reimbursement for mechanized vessels and fuel subsidy to canoe operators. It is evident from the study that majority of the respondents have availed fuel subsidy every year. Among the supplies of material provided by the government, safety equipment is availed by majority fishermen. Under the grant-in-aid welfare schemes, saving cum relief fund is popular among the fishermen. In case of contribution welfare schemes, government has invested maximum amount towards fishermen corpus fund. The government expenditure on the schemes is showing an increasing trend since 1990-2018. The per capita subsidy has shown an increasing trend from 2012-2018. Majority of the fishermen owning canoes have availed the subsidies on purchase of motorized canoes, gill net and replacement of kerosene to petrol motor. Among the three types of fishing crafts, the highest average amount spent on fuel is by fishermen owning purse-seine vessels as compared to trawlers and canoes. Fuel subsidy helps the fishermen to reduce the cost of fishing operations and increase the number of fishing days. The Fishers exact and Chi-square test indicates that the supplies of materials namely; safety jackets, lifebuoys and fuel subsidy has significant impact on the satisfaction level of the fishermen. Friedman's test results show that respondents have given highest ranking for the factor "Supply of diesel facilities by the societies" and lowest ranking for "Inadequate space for berthing vessels as well as cold storage facilities". The results of Independent sample *t* test indicates that there is significant difference in the satisfaction level of fishermen over fishing business in both the districts for the factors "Fishing as a source of livelihood and "Fishermen are happy to continue with ancestral fishing business". The two major problems faced by fishermen are "Inadequate space for berthing of vessels and cold storage facilities" and "Illegal fishing by mechanized vessels from neighbouring states." The fishermen from South Goa face highest problems on an average as compared to North Goa.

Some fishermen have not availed the schemes due to lack of time as they are personally involved in fishing operations, and also because of too many cumbersome government formalities and documentation process. The government also delays the process of sanctioning the amount on time to the respondents despite submitting the necessary documents. There is a need for the government to have consultation with the stakeholders as a key requirement for ensuring that the benefits of these schemes meet the objectives. Policy intervention is necessary to ensure monitoring of the schemes provided to the fishermen to ensure long term sustainability as well as nutritional security. The next chapter nine will discuss about the Findings, Suggestions and Conclusions emanating from the study.

Chapter 9

Findings, Suggestions and Conclusions

Chapter 9

Findings, Suggestions and Conclusions

9.1 Introduction

The fishing industry has its significant impact on the economy of the State of Goa and also on the nutritional diet of the people of Goa. The fisher folk population in Goa is approximately 30,225 out of which 11,944 i.e. 39.51% of the fishermen are actively involved in fishing activities. The State of Goa contributes around 3% towards marine and 0.10 % towards inland production of the country in terms of quantity which is very insignificant for the study period 1990 to 2017. The share of marine exports of Goa to the country is 2.34% and to the world it is 0.04% in terms of quantity for the period 1990 to 2017. India's earnings in foreign exchange from marine exports increased by four times from 1990-91 to 2016-17. During 1990-91, the State of Goa earned ₹ 821 lakhs foreign exchange which increased to ₹ 64,141 lakhs in 2016-17. In 1990-91, the fisheries sector share of GSDP to Goa's GSDP was 1.97%, but has now declined to 1.67% in 2016-17.

The trends in fish production (marine and inland), marine exports and the contribution of Goa's fisheries sector to the State's income has not been adequately researched. The variation in capital investments, costs, earnings and profits of the different categories i.e. size of motorized canoes, trawlers and purse-seine vessels in the two districts of Goa also has not been found in the knowledge area. The role of the Government in the form of schemes (subsidies, grant in aid, supplies of materials and contribution) promoted and disbursed by the Government for the welfare of the fishermen and the trends therein have not been investigated. Hence, this study attempts to fill the research gap. This study aims to answer the questions raised herein. What is the trend, growth, share of the fish production (marine and inland), and marine exports from Goa to the nation and to the world in terms of quantity since liberalization i.e. 1990-2017? What is the contribution of Goa's fishing industry to the state income and to the primary sector from 1990-2017? Is there a variation in capital investments, costs, earnings and profits among the different sizes of motorized canoes, trawlers and purse-seine vessels in Goa? What is the impact of the selected input of factors of production on the output of fish catch i.e. earnings from fishing business? Is the fishing business carried on by the traditional fishermen owning motorized canoes and mechanized (trawlers and purse-seine) vessels viable? What role does the government play in terms of disbursements of schemes and incentives to support the fishing business as well as the sustainable growth of the fishing industry? Are the fishermen satisfied with the subsidies availed from the Government? What are the problems faced by the fishermen owning traditional motorized canoes and mechanized vessels?

The objectives of this study are to analyze the trends in marine and inland fish production, marine exports and their contribution to Goa's State Domestic Product. To examine the variation in capital investments, costs, earnings and profits of the fishermen owning the different categories of traditional motorized canoes and mechanized vessels, both trawlers and purse-seiners**.** Finally, it studies the role of Government with respect to financial assistance in the form of schemes provided to the fishermen owning traditional motorized canoes and mechanized vessels in Goa.

The study relies on primary and secondary sources of data collected from a host of sources. The study uses the published time series data from 1990 to 2017 as the full period to study the contribution of the fisheries sector since liberalization. The study also uses primary data collected through interview schedule from the traditional fishermen owning motorized canoes and mechanized vessels (trawlers and purse-seiners) for the fishing season August 2016 to May 2017. The study is conducted among the population of 1875 operational fishing crafts in the Goan seas, which consisted of 1110 motorized canoes, 464 Trawlers and 301 Purse-seiners. The sample size taken for the present study is 291 owners of the motorized canoes and mechanized vessels, comprising of 140 motorized canoes, 78 trawlers and 73 purse-seine vessels in Goa. The sample size has been scientifically calculated using the Priscilla Salant and Don A. Dillman method. The sample size is found to be scientific and true representative of the population. The information is collected from the fishermen owning motorized canoes varying from size 26-38 feet in the two districts of Goa. The data is collected from fishermen owning trawlers of 3, 4 and 6 cylinders and varying between sizes 32-60 feet and purse-seine vessel owners having vessels of 4 and 6 cylinders varying between sizes 45-75 feet across the two districts of Goa. The motorized canoes are operated in the six talukas namely, Tiswadi, Bardez, Pernem in North Goa and Salcete, Mormugao and Canacona in South Goa. Trawlers operate at Malim, Chapora, Vasco and Cutbona jetties and purse-seine vessels operate at Malim, Vasco and Cutbona jetties. The empirical study conducted on the fishing industry by collecting data from various sources shows the various economic manifestations as well as the commercial interactiveness of the industry.

The techniques employed in the present study include the usual parametric and non-parametric statistical tools. The compounded annual growth rate (CAGR) are computed using the semi (*log-lin*) model to estimate the growth of marine, inland production and marine exports of the world, of the country and of the State of Goa in terms of quantity for the period 1990-2017. The CAGR method is also used to measure the growth of the government schemes provided by the government to the fishermen from 1990-2017. The Coppock Instability Index and the Coefficient of Variation is estimated of the world, country and the State of Goa. It is used to measure the instability index in order to evaluate the performance of marine, inland production and marine exports from 1990-2017. The study uses the Ordinary Least Square (OLS) method using linear and multiple regression as well as the log-log model of multiple regression. The parametric tests namely; independent sample *t* test and one way ANOVA post hoc test were used to test the hypothesis to investigate whether there are significant differences in the mean of variables, capital investment, costs, catch, earnings and profits among the different sizes of motorized canoes and mechanized vessels in Goa. The non-parametric tests such as Man Whitney U test and Kruskall Wallis test are used for testing the hypotheses relevant to the economic indicators of various ratios for the motorized and mechanized fishing crafts. The Independent sample *t* test, Friedman's test, Fishers exact test, and Chi square test are used to test the hypotheses regarding the satisfaction level of fishermen towards subsidies availed, and problems faced by the fishermen in fishing business in Goa.

The thesis is arranged into nine chapters. The study is introduced in Chapter -1 which explains the background, research problem, research gap, objectives, scope, chapterisation scheme and limitations of the study. Chapter-2 titled "Review of literature", reviews related literature and presents the research gap. Chapter 3 describes the related theoretical base, research methodology, and techniques. Chapter-4 is titled as "Contribution of Fishing Industry to Goa's Economy". This chapter explains the various fisheries legislations implemented and examines the trends and growth of fish production, marine exports and contribution of fisheries sector to State's economy. Chapter- 5 is titled "An Analysis of Costs, Earnings and Profits of Motorized Canoes in Fishing Business in Goa", Chapter-6 is titled "An Analysis of Costs, Earnings, and Profits of Trawlers in Fishing Business in Goa", Chapter- 7 is titled as "An Analysis of Cost, Earnings, and Profits of Purse-seine Vessels in Fishing Business in Goa". These three chapters examine the variation in capital investments, operating and fixed costs, earnings and profits of motorized canoes, trawlers and purse-seine fishing crafts in Goa. Chapter 8 titled "Role of Government in Promotion of Fishing Business in Goa" explains the trends, growth and disbursements of various schemes, namely; subsidies, supplies of material, grant in aid and contribution by the government to the fishermen. It also analyses the satisfaction level of fishermen availing the subsidies. It examines the satisfaction level of fishermen with present fishing business and problems encountered by fishermen in fishing business. It examines the facilities provided by the fisheries co-operative societies to the fishermen owning mechanized vessels.

This chapter is organized into five sections. Section 9.2 lists major findings of the study, section 9.3 highlights the policy suggestions emanating from the study, section 9.4 summarizes the conclusion, section 9.5 gives the contribution of the study and the last section 9.6 presents the scope for further research.

9.2 Summary of Major Findings of the Study

The study on commercial aspects of Goa's fishing industry is an attempt to analyze the contribution of the fishing industry to Goa's economy. It examines the economics of the fishing crafts operational in Goa. The researcher highlights the syntheses of the empirical findings which relate from chapter four to eight of the thesis which provide answers to the main research questions that are explored in the study. It also analyses the role of government support through various schemes towards the fishing industry in Goa. The findings of objective one are given in chapter four from point 1-5, objective two in chapter five to seven from point 6-18, and objective three in chapter eight from point 19-24. The major findings that emerge from the study are summarized as follows:

1. Since Goa's liberation the complete transformation of the economic activity from natural resources to manufacturing and tertiary sector industry has led to economic

growth. The results of semi-log regression model shows that CAGR of primary sector and fishing sector to State's GSDP shows negative growth but the CAGR of fishing GSDP to primary GSDP shows a positive trend. The contributed output of the primary sector to the State GSDP declined to 8.40% in 2016-17 as compared to 12.78% in 1990-91. The contribution of the fishing industry to Goa's GSDP measured in constant terms witnessed a drastic decrease by 2.5 times from 1990 to 2017. The average share of contribution of primary sector to Goa's GSDP declined drastically by more than half i.e. 2.23 times from 1990-95 to 2010-2017 period. However, the average share of the fishing industry to primary sector which was 16.66% in 1990-95 increased to 21.71% in 2010-17. In terms of marine exports revenue, the contribution of fisheries sector has increased to Goa's GSDP from1990 to 2017. The contribution of fishing to primary sector is showing an upward trend, but the contribution of fisheries sector to the State GSDP is showing a downward trend for the period 1990 to 2017. Marine production, exports, and exports to production ratio of Goa in terms of quantity showed significant growth of 1%, 8% and 7% respectively.

2. The share of inland fish production of India to the World is 9.19% and marine share is only 2.85% in terms of quantity for the period 1990-2017. However, the total share of fish production (marine and inland) of India to the World in terms of quantity is 4.61% for the period 1990-2017. The share of Goa's marine to the nation's marine production in terms of quantity is higher than the inland production for the full period. However, the total share of fish production (including marine and inland) of Goa to the country and Goa to the world has shown a downward trend for the period 1990-2017. The number of country crafts which were 4125 in 1960-61 decreased to 1962 by 2016-17 and the size which was 26-30 feet is increased to size 31-38 feet as per the government regulations. The number of mechanized fishing vessels which were four increased to 763 and the size of 32-40 feet is increased to a maximum of 75 feet from 1960-61 onwards till the period under study. Mechanization has led to increase in marine production from 1995-2000 till 2017. However, this has led to over-exploitation, overfishing, reducing fish catch of some important species, which is detrimental to the growth of fisheries sector.

3. In Goa, the major share i.e. 95% of marine production is from purse-seine fishing, followed by trawling, gill net and shore seine fishing by motorized canoes. The pelagic species occupies the dominant share through purse-seine fishing followed by

crustacean, and mollusc species. During 1990-2017 the catch of sardine species registered the highest positive CAGR of 9.31%, followed by prawns (shrimps) with growth of 5.54%, seer fish (kingfish) with a growth of 3.46%, respectively. Among the four jetties and other landing centers considered for the study, mechanized vessels at Cutbona jetty registered highest percentage of marine catch with 26.16% and Talpona with lowest catch of 0.70% for the full period. The CAGR of marine catch for Cutbona jetty is 0.08%. Talpona jetty has a negative CAGR 0.08% for the full period.

4. The major exporting countries of sea food products of India are Japan, USA, European Union, China, South East Asia, Middle East and other countries. The average marine exports of the world, country and Goa are showing an upward trend for the period 1990-2017. The analysis of the trend of marine products exports indicates a positive liberalization effect for the country and for the State. The fishing industry of the State of Goa is not cent percent export oriented. The percentage share of marine exports of Goa to marine production has increased from 10.86% in 1990-1995 to 37.71% during 2010-2017 depicting an increasing trend with a CAGR of 7%. Since, 1990 to 2017 period, Goa's overall marine exports share accounted to 22.68% of the total marine production in terms of quantity. The marine exports of Goa in terms of quantity and value has increased from 1990 to 2017 and has positively affected Goa's GSDP. Among other importing countries, South East Asia from 1995 to 2017 has maintained its relative importance as the largest importer of Goa's marine exports, followed by China and other countries consecutively for a period of 22 years. The marine exports from Goa in terms of quantity to South East Asia were 63.98%, followed by China 21.02%, and other countries with 5.45% respectively. However, Goa's marine export to USA has decreased drastically from 1.09% in 1990-95 to 0.02% in 2010-2017.

5. The contribution of average marine exports from India to the world has increased from 0.55% in 1990-95 to 3.34% in 2010-2017 i.e. more than 6 times, whereas Goa's share of marine exports to the world has increased from 0.02% to 0.06% i.e. by 3 times for the same period. The reasons for the increase in marine exports are the opening of new markets, removal of restriction on trade, increase in aquaculture production, increase in exports of value added sea food products and adaption of the international standards for exporting marine products. All this factors has led to

increase in growth of marine exports from the country by 1.65% and from State to the world by 0.04 % for the period 1990-2017. The coefficient of variation of fish production (marine and inland) is high for the county i.e. India whereas it is same for Goa and world. Coppock instability index reveals similar results where it shows high instability for fish production for India followed by world and Goa. The coefficient of variation shows highest variation of export of fish from Goa as compared to India and the world. Coppock instability index for marine exports shows high instability for Goa followed by India and the world.

6. The socio-economic profile of the fishermen owning canoes, trawlers and purse-seine crafts shows that the average age group of fishermen involved in fishing business is between 46-55 years and they belong to middle age group. Majority of them had secondary qualification and belonged to OBC category, locally known as "*Kharvi*" community. The ST respondents are found among fishermen owning canoes. There are no ST respondents among fishermen owning trawling and purse-seine vessels. The average size of the family among fishermen owning canoes is five and for trawler and purse-seine owners it is four. The average experience of the fishermen in fishing business is between 16-30 years. Most of the respondents reported that at least one member of the family is actively involved in the fishing activity. This study finds that majority (42.1%) of the fishermen owning motorized canoes were still living below poverty line. The fishermen owning trawlers and purse-seine vessels belonged to APL category. The fishermen owning motorized canoes cannot afford to make higher capital investments due to low income and due to their operation of fishing business on small scale.

7. Fishing business is fishermen's main source of livelihood and their family business. Almost 85% of the fishermen owning canoes, 88% owning trawlers and purse-seine vessels have registered on an average between 1-2 fishing crafts in their names. The fishermen avail the loan facilities from formal and non-formal sources for their fishing activities. The formal sources are banks. The non-formal sources are the advances from fish trade agents, "*confraria"*, i.e. chit funds a type of savings, relatives and friends. In the study area, fishermen owning canoes have taken loans from banks, and non-formal sources, whereas trawler and purse-seine owners have taken loans from agents, followed by banks and other non-formal sources. The loans were taken for building/purchase of fishing crafts, procurement of fishing gears and

other equipment. The canoe owners have used self-finance approximately upto 51%, trawler owners upto 60% and purse-seine owners upto 76% as compared to the loan money to purchase fishing craft and equipment. The fishermen owning canoes have taken loan on an average for two years, trawler owners for three to four years and purse-seine owners for five years in both the districts. Fishermen owning canoes have not taken loans to purchase petrol motor and safety equipment. This is because they avail subsidy of 75% i.e between ₹ 90,000 to ₹ 1,00,000 from the government to replace kerosene motor with petrol motor. The average debts of the fishermen owning canoes was ₹ 1,47,256, trawler owners ₹ 5,56,923, and purse-seine owners ₹ 21,72,329 respectively. The Government provides agricultural loans up to ₹ 5,00,000 at 4% subsidized interest per annum for fishing activities after every five years, but only few fishermen owning mechanized vessels availed it due to cumbersome government formalities. There are no self-help groups providing finance to the fishermen in the study area.

8. The average amount of total capital investments incurred by fishermen for the 26-30ft size motorized canoes is ₹ 2,44,902, for 31-38ft motorized canoe ₹ 3,69,157, and for the trawler and purse-seine vessels for the size of 32-75 feet, the costs ranges between ₹ 40,00,000 to ₹ 1,00,00,000 and above. The average costs of small size trawler is ₹ 12,42,265, medium trawler ₹ 18,30,538, for large trawler ₹ 21,03,272, for medium size purse-seine vessel ₹ 58,48,750, and large size purse-seine vessel ₹ 1,02,24,169. The fishermen owning motorised canoes earned an average income of ₹ 2,31,939 in North Goa and ₹ 3,03,638 South Goa for one entire fishing season and they belong to the lower income category. Fishermen owning trawlers earned an average income ranging from ₹ 19,24,930 in North and ₹ 14,93, 875 in South Goa and they belong to upper income group category. Fishermen owning purse-seine vessels earned an average income ranging from ₹ 33,83,259 in North Goa and ₹ 43,18,695 in South Goa and they belong to upper income group category. The average savings for entire season for canoe owners is ₹ 58,093, ₹ 2,59,551 for trawler owners and ₹ 732,205 for purse-seine owners. The average household expenditure per annum for canoe owners is ₹1,22,855, ₹ 2,52,679 for trawler owners and ₹ 421,917 for purse-seine owners.

9. The cost of hull of the motorized canoes and fishing gears were the major items of capital cost for fishermen owning canoes. The costs of hull and reconditioning were

the major items contributing to the total capital cost for trawler owners and costs of hull and fishing gears were major part of capital cost for purse-seine owners. Reconditioning costs is incurred by fishermen mostly on small and medium trawlers and medium purse-seine vessels which were more than 10-15 years old. Out of the total operating costs, the highest average cost incurred by the fishermen is on fuel followed by wages. The average costs on fuel incurred by fishermen ranges between 34% to 35% and wages from 32% to 34% for 26-38 feet canoes. The average cost on fuel is highest ranging from 40% to 50% and wages of labour varying from 27% to 29% across small, medium and large trawlers. The average fuel costs ranges from 37% to 38% and wages about 35% to 36% for the medium and large purse-seine vessels. The average costs on depreciation on hull, fishing equipment followed by interest on loan is major part of fixed cost for canoes, trawlers and purse-seine crafts.

10. The average fishing trips varies between 230-236, fishing days 230-225 and the fishing hours were 696-864 for 26-38 feet canoes. The average fishing trips were 161 for small, 102 for medium and 45 for large size trawlers. The average fishing days are 205 for small, 201 for medium and 216 for large size trawlers. The average fishing hours are 848 for small, 892 for medium and 1133 for large size trawlers. The average fishing trips are 46 for medium and 40 for large size purse-seine vessels. The average fishing days are varying from 215-224, fishing hours ranging from 1018-1024 for medium and large size purse-seine vessels. The fishing days, fishing trips and fishing hours are totally dependent on weather, climatic conditions, season, and availability of fish catch. The respondents owning mechanized vessels stated that 10 to 15 years back the fishing trip duration was on an average of five days requiring less fuel. But over the recent years, the situation has changed as the overexploitation of the marine resources has caused non-availability of fish in the closer vicinities. Hence, the medium and large size mechanized vessels venture for deep sea fishing in search of shoals of fish, leading to increased cost of operation, and more fishing days during mid-December to May.

11. The findings of the study show that the average total costs per trip is ₹ 1650 to ₹ 3,074, the total catch per trip is 19 kgs to 34 kgs, the gross revenue per trip is ₹ 2102 to ₹ 3,747, the gross profit per trip is ₹ 663 to ₹ 995 and the net profit per trip is ₹ 452 to ₹ 672 for 26-38 feet canoes. The total costs per trip for small sized trawlers is ₹ 15,138, for medium ₹ 32,729 and for large ₹ 76,657. The total catch per trip for small

size trawlers is 122 kgs, for medium 317 kgs and for large 956 kgs. The gross revenue per trip is ₹ 13,290 for small, ₹ 36,361 for medium and ₹ 107,279 for large sized trawlers. The gross profit per trip is ₹ 4312 for small, ₹ 9279 for medium and ₹ 22,807 for large sized trawlers. The net profit per trip is ₹ 3666 for small, ₹ 7593 for medium and ₹ 18,138 for large sized trawlers. The average total costs per trip is from ₹ 1,63,219 to ₹ 2,22,215, total catch per trip is 2147 kgs to 2681 kgs, gross revenue per trip is ₹ 1,99,104 to ₹ 2,58,993, gross profit per trip is ₹ 52,909 to ₹ 67,852, and the net profit per trip is between ₹ 35,887 to ₹ 36,778 for medium and large purse-seine vessels. The total operating costs, fixed costs and total cost per trip is highest for purse-seine vessels followed by trawlers and motorized canoes. The gross revenue (earnings), gross and net profit per trip is highest for purse-seine vessels, followed by trawlers and motorized canoes.

12. In both districts, namely; North and South Goa, majority of the family members of the fishermen owning canoes are personally involved in selling the fish in the retail markets, to the wholesale market, and to the middlemen fish trade agents. The fishermen owning trawlers and purse-seine vessels in both the districts sell their bulk fish catch to the fish trade agents at the jetties depending on the price negotiated between them. However, if the fishermen get less sale price from the agents they sell it in the wholesale and retail markets. Selling to middlemen agents sometimes reduces the net profit of the fishermen. The trawler and purse-seine owners having large vessels transport their fish catch to other States, sell their highly priced catch to the fish processing units, which is later, exported and their low priced catch and discards to the fish meal plants.

13. Goa’s fishing industry is not only totally dependent on migrant labour, but it is a source of employment to them. Most of the fishermen owning motorized canoes themselves carry out the onboard fishing activity. However, among trawler and purse-seine owners, the fishing activity is mostly carried out by the crew employed on the vessel. The number of labourers employed depends on the size of the fishing craft. The fishermen owning purse-seine vessels provide on an average employment to 25 to 35 crew, trawlers owners employ an average of 3-12 labourers and the motorized canoe owners employ an average of 1-7 employees per fishing craft. The lesser number of employees from Goa on the fishing crafts can be attributed to the fact that majority prefer to migrate abroad. The rest are employed in the manufacturing and

service sector. Majority of the fishermen provide food, medical reimbursement, and other compensation benefits to their employees. Most of the migrant employees working on mechanized vessels stay on board and hence there is no necessity of providing accommodation facilities to them. The canoe owners provide accommodation facilities to the migrant employees and some stay in rented premises.

14. The study of economic and financial indicators through ratio analysis shows that overall large size trawlers and purse-seine vessels performance is better than the small and medium vessels. Large size trawlers and purse-seine vessels in Goa are more viable enterprises, as compared to small and medium sized trawlers and medium purse-seine vessels. In terms of input output efficiency ratios, the performance of motorized canoes is better as compared to the trawlers and the purse-seine vessels. As regards payback period, fishermen owning motorized canoes recovered their investments within an average of less than two years, trawler owners within two to four years, and purse-seine vessel owners within three to six years. The average rate of return and benefit cost ratio is the highest for motorized canoes, followed by the trawlers and the purse-seine vessels. The average break-even-point is highest for purse-seine vessels, followed by motorized canoes, and trawlers. The average labour productivity is higher for purse-seine vessels, followed by trawlers and motorized canoes. Most of the fishing crafts were running into reasonable profits as shown by the economic and financial indicators. Purse-seine method of fishing using purse-seine net helps fishermen to get more fish catch, as compared to trawl and gill nets.

15. The fishermen owning trawlers and purse-seine vessels use fish finders and a few use sonar (fish detection device) a modern technology to locate the shoals of fish. Such equipment helps them to reduce the searching time, reduces fuel consumption, helps to get more fish catch and earn more gross revenue. Fishermen also use mobile phones, navigation devices and other equipment for fishing operations. This helps the fishermen to recover the costs incurred and earn sufficient net profit from their fishing units. The fishermen stated that August to November is a favourable season for fishing as export quality prawns and highly priced fish species are available, fetching more gross revenue compared to the months from December to May.

16. The multiple regression model is used with the objective to study the impact of socio-economic characteristics of fishermen owning canoes, trawlers and purse-seine crafts, on the dependent variables, net profits, earnings and savings across canoes,

trawlers and purse-seine fishing crafts. The estimated values of multiple regression model indicates that gender i.e male canoe owners, OBC caste (dummy variables) and APL respondents (taken as income category) has a positive and significant impact on the dependent variables, net profits and earnings from motorized fishing business. In the second multiple regression model, when dependent variable is savings, the family members involved in fishing business, educational qualification, turned out to be significant along with caste i.e. OBC and income category i.e APL respondents for canoe owners. In case of trawler owners, when multiple regression model is used, the independent variables, namely; gender i.e. male respondents and educational qualification have significant positive impact on the net profits. The APL (taken as income category) respondents have significant positive impact on earnings of trawling business. The independent variables, namely; educational qualification and APL (taken as income category) has significant positive impact on savings of trawling business. The independent variables, gender i.e. male and OBC category respondents has a significant positive impact on net profit, earnings and savings from purse-seine fishing business. Fishing in Goa is male-dominated activity, majority of them were male respondents involved in fishing activities, the female respondents have only registered crafts in their names and some are involved in ancillary activities. In case of OBC caste it is their ancestral business and they have learnt the techniques of fishing from their ancestors, which helps them to locate right fishing grounds, to get more fish catch, increase their gross earnings, net profit and savings.

17. The Alfred Weber’s location theory, assumes that a business will flourish in a location where all facilities are available in close proximity. The location theory using linear regression model is used to study the impact of districts on the dependent variables, net profit, earnings and savings from the fishing business. The results of linear regression model indicated that District, South Goa has a significant positive influence on the net profits, and earnings of motorized canoe business. This is because in South Goa, Mormugao and Salcete talukas have the advantage of better fishing grounds, majority of the fishermen use canoes of size 36 feet and are involved in mini purse-seining method of fishing. These factors help them to get more fish catch as compared to respondents from North Goa. In case of trawl fishing business, the district North Goa when compared with South Goa has positive significant impact on net profit and earnings. This is because in North Goa on Malim jetty there are better

facilities provided by fisheries co-operative societies such as ice plant, fish stalls, grocery and spare parts. There are more number of large sized trawlers engaged in multi-day deep sea fishing in North as compared to South Goa. When purse-seine fishing business is considered, district, South Goa has positive significant impact on net profit, earnings and savings from fishing business. This is because Cutbona in South Goa is the biggest jetty and has facilities such as bigger space for berthing, it is closer to the whole-sale market, retail markets and there are large size purse-seine vessels which venture into deep sea multi-day fishing bringing more fish catch. In addition to this, the fisheries co-operative societies also provide facilities such as mending of nets and availability of spare parts.

18.The Cobb Douglas production function model with the help of log-log model of multiple regression is estimated to identify the selected factors of production influencing fish output i.e. earnings from fishing business for motorized canoes, trawlers and purse-seine fishing crafts. The results of the log-log model indicate that the independent variables, namely; horsepower of the motors, fishing hours, and cost of fuel has positive significant impact on the output of fish of motorized canoes. In case of trawlers, the variables, namely; horse power of engine, wages paid to the labour and fishing hours has positive significant impact on the earnings. For purse-seine vessels, the variables, wages paid to labour, fishing hours, and cost of fuel has significant positive impact on the earnings. However, the variable fishing trips has negative influence on the earnings from fish catch in case of motorized, trawling and purse-seine fishing business. A mere increase in fishing trips, but a poor catch will have a negative effect on earnings as it will only increase the operational costs. There is ample scope for fishermen to increase their earnings from the fishing business by increasing the selected independent variables which have significant and positive correlation and impact on the earnings from fishing business.

19. The State Government provides the information of all the schemes to the fishermen through fishermen associations and co-operative societies. They provide assistance to the fishermen to apply and avail the government schemes. The fishermen operating trawlers and purse-seine vessels have to be registered as members with the fisheries co-operative societies. Fishermen from all the four jetties operating mechanised vessels are happy with the fisheries co-operative societies regarding the facilities i.e supply of diesel, credit availed for the supply of diesel as well as the

information given on the various government schemes, rules and regulations. As per Friedman's test, the respondents have given highest ranking for the factor "Supply of diesel facilities by the societies" and lowest ranking for "Inadequate space for berthing vessels and cold storage facilities". Results of Independent sample *t* tests shows significant difference for the variables namely; "Availability of adequate space for landing of vessels", "Availability of ice plant and cold storage facilities" and "Availability of fish selling outlets". The fishermen have to berth their vessels in their jurisdiction at respective jetties and use the facilities only where they are registered as members of fisheries co-operative societies. The facilities are not uniform across all the jetties. Thus, there is a significant difference as regards facilities availed by fishermen in respective jetties situated in North and South Goa.

20. The total average expenditure incurred by the Government on all the various schemes from 1990-2018 is ₹ 811.47 lakhs and it shows an upward trend and has increased over the years. For the period 1990-2018, the CAGR of the schemes, namely; subsidies is 16.39%, grant in aid 8.95%, contribution 42.75%, total supplies 12.58% and the total CAGR of all the schemes is 16.03%. Among all the schemes and incentives disbursed by the government from 2012-2018, it is found that the maximum expenditure is incurred on the top two popular subsidies namely; fuel subsidy to fishermen owning canoes and 100 % VAT diesel reimbursement on fuel to mechanized vessel owners. Majority of the fishermen owning motorized canoes and mechanized vessels have availed the fuel subsidy every year. The next two popular subsidies are replacement of kerosene motor to petrol motor and construction of wooden/fibre reinforced plastic which are availed by fishermen owning motorized canoes. The least popular schemes are financial assistance for purchase of power blocks and financial assistance to brackish water aquaculture farm. As far as the supplies of material schemes are concerned, insulated boxes were supplied to maximum fishermen by the government. Under the category of grant-in-aid welfare schemes, the saving cum relief scheme is availed by maximum beneficiaries, in which relief is given by the government of ₹ 2700 per fishermen during the lean season for June and July. Regarding the contribution schemes, the Group Accident Scheme is applied by maximum beneficiaries, under which the government invested in insurance cover for maximum beneficiaries. In case of contribution welfare schemes, as per the government regulation, it is mandatory for the owners of fishing crafts since 2013 to

invest ₹ 200 on himself and for every employee in corpus fund for five years towards the insurance policy. The government invested ₹ 898.93 lakhs towards fishermen corpus fund and fishermen invested ₹ 170.81 lakhs from 2013-14 to 2017-18. This amount will be given by the government to the fishermen as relief in case of natural calamity. Some fishermen have not availed the schemes due to cumbersome government formalities. The per capita subsidy shows an upward trend for the period 2012-13 to 2017-18, but per capita supplies and per capita grant-in-aid shows considerable variation over the years, but is highest in 2016-17. This is due to the extra funds sanctioned by the Central Government in 2016 to all the maritime states of India under the revised scheme of Blue revolution. This is a positive initiative in improving the socio-economic conditions of the fishermen as well as for the overall development of the fishing industry.

21. The State Government gives fuel subsidy of ₹ 51,000 per canoe for the maximum consumption of 1700 litres of fuel per season. The fishermen owning mechanized vessels from size 32 to 75 feet i.e 3, 4 and 6-8 cylinders, receive an average diesel VAT reimbursement subsidy on fuel from government per mechanized vessel between ₹ 120,000 to ₹ 240,000. The average amount spent by fishermen on fuel per canoe is ₹ 2,12,244 and average subsidy received is ₹ 45,000 i.e. 21%. The trawler owners spent an average amount on fuel of ₹ 12,24,694 and receive subsidy of ₹ 1,65,867 per trawler i.e. 13.54%. The average amount spent on fuel per purse-seine vessel is ₹ 27,61,514 and subsidy received is ₹ 217,947 i.e. 7.89%. Fuel subsidy is given after deducting corpus fund. Fishermen benefit from fuel subsidy as it helps them to reduce the cost of fishing operations and increase the number of fishing days. The results of Fishers exact test and Chi square test shows that there is a significant difference on the satisfaction level of fishermen for the schemes, namely; supply of safety jackets, fishing equipment and fuel subsidy in both the districts.

22. The results of Friedman’s test shows that the economic factor, “Fishing business as a source of livelihood provides direct and indirect employment”, is considered as a significant factor, has an impact on the satisfaction level of fishermen. The results of Independent sample *t* test show that fishermen from South Goa are more satisfied than fishermen of North Goa as regards the economic factor “Fishing business as a source of livelihood” and social factor “Happy to continue ancestral traditional business”.

23. The Friedman’s test results indicate that the two major problems fishermen face are “Inadequate space for berthing of vessels, lack of cold storage facilities” and “Illegal fishing by mechanized vessels from neighbouring states”. Besides these, other problems which are significant are damage to fishing equipment, problems due to illegal fishing such as high speed boats, bull trawling, LED fishing, increase in the cost per trip, and unavailability of cold storage facilities. The Independent samples test results show that there is a significant difference for the variable, “lack of infrastructure facilities” across fishing ramps and jetties in both the districts of Goa. As per descriptive analysis, fishermen from South Goa especially from Vasco jetty face major problems in fishing business as compared to North Goa. The other problems encountered by all fishermen are lack of availability of skilled labour. The failure of the labourers to return at the commencement of the fishing season, considerably affects the operations of the fishing activity in the study area.

24. Most of the fishermen opined that the fish catch is declining in the recent years. The reasons attributed to the decline are illegal fishing activities, such as bull trawling, led fishing, use of mesh size of fishing gear below 20 mm for prawns and 24 mm for fish, and the use of high speed boats which destroys fish breeding grounds. It must be noted that illegal fishing activities continue despite being banned by the government. The increasing plastic waste in the sea which gets entangled in their fishing nets and oil spill is also a major problem for the fishermen.

9.3 Policy Suggestions of the Study

Based on the findings this study makes certain suggestions and conclusions for the upliftment of the fishermen and the development of the fishing industry in Goa. It is evident that over the years, the Central and State Governments have taken efforts to develop the fisheries sector, but further initiative to develop the fisheries industry will invariably benefit the nation as a whole. The policy makers would be able to make use of the findings of this study for incorporating measures that would enhance the fishermen’s fishing business in Goa. The suggestions are classified in three categories; sections 9.3.1 are suggestions to the fishermen and section 9.3.2 are suggestions to the government.

9.3.1 Suggestions to the Fishermen

1. The findings of the study shows that the large size fishing crafts help the fishermen to earn more profits. Hence, it is suggested that fishermen should invest in large size fishing crafts to increase their net operating income which will improve their socio-economic conditions. Government support in the form of schemes is a necessity.

2. The findings show that the major operating cost is on fuel. The fishermen should get familiarized with the use of fuel efficient fishing methods. Fishermen could be trained by the government through fisheries co-operative societies to install knort nozzle efficient propulsion on their crafts in order to increase the fuel efficiency. Fishermen should also be trained to handle the modern equipment, various types of fishing gears and adopt hygiene sanitary practices on board the craft as well as at the landing centers. The government should sensitize the fishermen on regular servicing and maintenance of the engines to save fuel consumption.

3. The fishermen owning medium and large vessels should invest on the insulated trucks by availing government subsidy to transport the surplus and highly priced species of fish catch to other States in order make their business profitable. It will help them to get better price for their catch, rather than selling it to the fish trade agents.

4. As per the findings of the study, the fishermen owning canoes and mechanized vessels spend almost 2% of the total operating costs every year on bamboo baskets for marketing the fish catch. Since these baskets get spoiled easily within less than a year, the fishermen could replace these baskets with aluminum baskets which are more durable and hygienic.

9.3.2 Suggestions to the Government

The suggestions are classified in two categories, those which can be implemented immediately and those that can be implemented in the long run.

9.3.2.1 Suggestions for Immediate Implementation

Following are the suggestions to be implemented with immediate effect.

1. The fishing industry in the State plays a significant role in augmenting supply both in domestic and export markets. Since the contribution of the inland sector of Goa is negligible i.e. only 4% and marine production is 96% from 1990 to 2017, it needs special attention from the Government. This could be done by using the inland and

aquaculture resources of the State to the fullest potential to increase inland fish production. Awareness programmes on aquaculture in the seas and estuaries among the stakeholders could be organized. Open sea cage farming as a livelihood could also be extended to the fishermen. In order to increase fish production in the State, the thrust of development should be on sustainable deep sea fishing, brackish water and aquaculture resources. The sustainable increase in marine and inland production of Goa can be utilized successfully to further increase the marine export trade in the international market. This will help to uplift Goa's fishing industry.

2. The findings indicate that the fishermen invests huge amount on capital investment as well as incur high operating and fixed costs on their fishing crafts. Government could initiate interest free loans to meet their financial exigencies as well as create awareness among fishermen on the importance of availing finance from credit institutions. Government could increase the existing amount of subsidy of ₹ 60,000 on hull to a higher amount.

3. The findings indicate that fishermen owning canoes spend maximum amount of their gross revenue on fishing gears every year as they get damaged due to frequent use. Hence, government could enhance the existing subsidy on fishing gears from ₹ 30,000 to a higher amount and to be given after every two years instead of four years.

4. As per the findings from the study, the cost of reconditioning incurred by the fishermen on mechanized vessels after every 10-15 years varies from 25% to 40% of the total capital investment. Hence, subsidies should be provided by the Government to the mechanized sector for the purchase of engines as well as for reconditioning. Government should supply quality lifesaving and other equipment to the fishermen.

5. The findings show that there are inadequate infrastructure facilities for berthing of fishing crafts, hence fishing ramps need to be built for the canoes at Nauxea, Temwada, Sinquerim in the district of North and in Baina, Vasco, Velsao, Bogmalo, Rambagh, and Palolem in South Goa. The non-operational fishing ramps for canoes need to be renovated for the purpose of safe berthing. The sand bars hamper the fishing activities at Chapora jetty affecting the income of fishermen. The fishermen incur very high cost for maintenance of vessels at Vasco, Malim and Chapora jetties. Therefore, the government should reclaim the land in water, make immediate provision for dredging and extend these jetties so as to make sufficient space to

accommodate all the mechanized vessels. Hence, provision of better infrastructural facilities across all the fish landing centers will help the fishermen to reduce the cost of repair and maintenance and increase the life of their fishing crafts.

6. The fishermen do not get the true value for their fish catch due to lack of post-harvest infrastructure facilities at the landing centers. Therefore, Government should establish facilities such as provision of cold storage plants, ice plants, auction halls and market facilities close to the landing centres in all the seven coastal talukas of Goa. This initiative will help the fishermen to transport fish catch easily from the fish landing center to the place of consumption and also will be able to store the surplus catch in the cold storage facilities inorder to earn reasonable return.

a. Government may establish ice plant facilities at Vasco and Chapora jetties.

b. Provision could be made for better road connectivity in many coastal villages of Goa, such as at Cacra, Odxel, Nerul, Temwada, Rambagh, and Sadolxem so that fishermen could transport their fish catch easily to the market.

7. Policy makers could initiate measures to develop and improve the sales and network of marketing distribution system. Government could set up some fish outlets and start mobile fish insulated vans under Fisheries Corporation in the villages in Goa so that the people will get fresh fish at reasonable rates. The Government could provide and modernize the cold storage facilities in the fish markets in Goa. Besides this, maximum fish catch would be available with better safety standards for human consumption as well as for sea food exports. The government should also ensure that the fish markets are maintained under hygienic conditions. Government should set an Apex Fisheries Co-operative society for marketing of fish resources to avoid the monopoly of few middlemen agents exploiting the local fishermen from earning their income. The marketing of fish could be managed by the fishermen in co-operation and supervision of the Fisheries Department. This initiative by the government will help the fishermen to get better price for their catch. The monopoly of the agents can be avoided if the Government exercises strict supervision in the wholesale and retail markets as well across the jetties. The Government could also implement policies for the retailers to sell fish on kg basis and not in the traditional "*vanto*" basis so that consumers will get fish at reasonable rates. Since there is no wholesale fish market in North Goa, there is a need to construct the same.

8. The Government should make provision of infrastructural and hygiene facilities at all fish landing centers in Goa. Government could provide washroom, drinking water and recreational facilities for the fishermen and crew at Vasco, Malim and Chapora jetties. Government through policy decisions shift liquor bars and restaurants situated closer to the jetties to other locations. This is because in the past, labourers under the influence of alcohol have lost their lives on board the vessel. The migrant and local crew should be provided with health cards and periodicial health check-up.

9. Considering the frequent cyclonic natural calamities in the seas of Indias peninsula, Government should allow the fishermen to use sateliite phones for communication instead of mobile phones. This will help fishermen to know about the changing weather conditions and natural calamity when they take vessels for deep sea fishing.

10. The Government should strictly ban the use of formalin in fish. The authorities such as Food and Development Authority (FDA) and Fisheries Department should have strict vigilance on the fish brought into Goa from the different coastal States of India to check the formalin in the fish. All insulated trucks entering Goa with fish should be certified by FDA. The Government should make registration for fish traders mandatory with valid licence issued by the FDA . The Fisheries Department should check the quality of fish at the fish markets and report complains if any to the FDA. There is a need to establish labs of Quality Council and Export Inspection Council to check the presence of formalin in the fish for the safety of human consumption.

11. The Fisheries Department should have strict vigilance at the landing centres to ensure that fishermen do not use the fishing gears of mesh size below 20 mm for prawns and 24 mm for fish. The government could increase the existing mesh size by amending the MFRA Act 1980 to reduce by-catch, juvenile fish catch and ensure sustainability of marine resources.

12. The fishermen stated that illegal fishing by fishermen using high speed boats with more than 600 horsepower engine, bull trawling and LED fishing needs to be banned in all the maritime coastal States of India. The Government should sensitize the fishermen on the dangers of illegal fishing activities which results in exploitation of the existing fishing zones and destroys fish breeding grounds. Government should enforce strict monitoring system to check the illegal fishing in deep sea. This will help to protect the fish breeding grounds and reduce further depletion of marine resources.

13. Pollution in the sea through disposal of industrial waste, and garbage contaminated with plastic needs to be effectively controlled. There is a need to devise innovative method to check coastal pollution.

14. The Government should involve the members of the fishermen associations and the fisheries co-operative societies in the making of legislations and regulations for the benefit of the fishing community.

15. The Government could encourage savings among the fishermen through self-help groups and enhance the savings relief scheme for fishermen for BPL category from ₹ 3,000 to higher amount.

16. The Annual Aqua fish festival held in 2017-18 in Goa brought revenue of ₹ 10 lakh causing loss of ₹ 5.3 crores to the state exchequer. The fishermen suggest that it could be discontinued as it does not help the fishing community. However, the government should review it so as to promote the interests of the fishing community and of the society at large. The funds could be utilized for the development of the infrastructure for the fishing industry.

9.3.2.2 Suggestions to be Implemented in the Long run

1. As per the findings, fishermen owning motorized canoes spend an average of 30% to 35% and those owning mechanized vessels spend 40% to 50% on fuel out of the total operating costs for one fishing season. But they receive subsidy from government about 7.73% to 29.13% which is inadequate. The fishermen are unhappy with the existing structure of fuel subsidy. Hence, Government should review the existing fuel subsidy in the light of increasing fuel prices and long hours of fishing trips.

2. In Goa there is dearth of boat building, repair yards, fish processing and ice plant factories, fish meal plants, net repair and mending yards. Those which are available are in the monopoly of private entrepreneurs. Government could establish these facilities closer to the fish landing centers and provide the services to the fishermen at reasonable rates. The Government could provide the service of insulated trucks and refrigerators to the fishermen across all the fish landing centers to transport fish and fish products to other States, as some fishermen cannot afford to purchase insulated trucks despite 50% subsidy provided by the government.

3. The fishermen association namely "*Goencho Ramponkarancho Ekvott*" is run through the personal monthly contribution of the fishermen owning motorized canoes. There are also fisheries co-operative societies across jetties for fishermen owning mechanized vessels. The Government disburses the fuel subsidies to the fishermen through these associations and societies. The fishermen are happy with some of the facilities provided by these fisheries co-operative societies. The Presidents of the fishermen associations and Chairmen of societies feel that ₹ 50,000 for administration purpose is a very meager amount. Government should increase the existing subsidy of ₹ 50,000 to a justifiable higher amount so that these 17 associations and 7 societies could provide need based assistance and services to the fishermen.

4. Fish is a natural resource but if the exploitation of the resource is not monitored by the Government it would lead to further depletion and extinction of marine species. The conservation and management of fisheries involves sound fisheries legislation, which will build, restore, maintain the fishery resource and the marine environment of Goa. In the interest of conservation of fisheries resources, subsidies which lead to illegal fishing, overfishing and overexploitation should be curtailed and Government should revamp the schemes which will encourage sustainable growth of the fishing industry. The Government through Fisheries Department should invest in protecting the marine life and rejuvenate the extinct species. This could be achieved by notifiying ecomarine sensitive areas and even restricting fish catch in these areas. The existing MFRA Act (1980) of the coastal States needs amendments so as to incorporate the mechanism of the monitoring controlling and surveillance system and a code of conduct for responsible fisheries. The existing monitoring, controlling and surveillance system in the State needs to be made stringent to maintain harvest at sustainable level and conservation of fish stocks for the future generation.

Fisheries management is not only managing fisheries resources but managing people directly involved in fish and fish related activities. The fishermen should follow all the rules laid down by the government regarding sustainable fishing. This will help to avoid the overexploitation of the fisheries resources and thereby conserve it for the future generation. Good governance and management of fishing industry of Goa is essential. Conservation and sustainable development of the fishing industry could be achieved through the collective effort of all the stakeholders. In order to ensure the sustainable use of marine living resources, developing strategies is very important for the State of Goa. This sector thus is in need of urgent management and rehabilitation policies. It is here that the Government of Goa can provide innovative solutions.

9.4 Conclusion

Following are the major conclusions that emerge from this study:

1. This study presents an overall view of the fishing industry in Goa as a whole and indicates the positive and negative factors therein. Fish is an important component of the diet of the people of the State. The fishing industry over the years has provided livelihood to the fishermen in Goa thereby improving their socio-economic status. The contribution of fishing industry to the primary sector shows an upward trend for the period 1990-2017. Goa's share of marine production of Goa to the national production in relative terms is higher than the share of inland production. However, the marine and inland production is showing a fluctuating trend. The contribution of fishing GSDP to the State's income is declining for the period 1990-2017. Studies by CMFRI have shown that the main reasons for the decline in the marine fish catch and the extinction of marine species are overexploitation, El Nino effect, climatic changes, high speed boats, illegal methods of fishing, overfishing and pollution that destroy the fish breeding grounds. The marine exports of Goa in quantity and value have shown an upward trend for the period 1990-2017 and it is similar to the trend prevailing in the rest of the country.

2. Being an industry in the primary sector, the State of Goa has a role in monitoring and financially supporting the industry. The Central and the State Governments play a significant role as they support the fishermen through the various schemes, which have benefited the fishermen in their fishing business. The Government also provides infrastructure facilities for the development of the fisheries sector. The subsidy provided by the government on inboard motors to the traditional sector has helped the fishermen to shift from non-motorized fishing canoes to motorized fishing canoes. Motorization reduces the strain on fishermen and helps them to reach quickly to the fishing grounds and fish landing centres. The technological revolution in the fisheries sector, government regulations and subsidies provided has led to the increase in the number of large size mechanized vessels in the form of trawlers and purse-seiners. The use of advanced technological equipment has helped the fishermen in the

mechanized sector to venture into deep sea fishing. Motorization and mechanization has led to creation of employment opportunities, income generation helping the fishermen to improve their socio-economic livelihood. Fishermen owning motorized canoes have also shifted to building large size trawlers and purse-seine vessels.

3. Fishing is the major source of income for all the fishermen involved in this business in Goa. However, some fishermen are also involved in secondary activities such as water sports, retail, export processing units, agriculture and service. As compared to the fishermen owning motorized canoes and trawlers, the fishermen involved in purse-seine fishing have made huge capital investments, incurred highest operational and fixed costs and have earned higher profits. Comparatively, canoe owners have made the lowest capital investment, have incurred less operational and fixed costs and have earned lower profits as compared to trawler and purse-seine owners. This is because fishermen owning canoes have small size canoes varying between 26-38 feet, use shore seine and gill net for fishing. They do fishing in shallow waters on small scale on an average of 3-5 hours, and get less fish catch as compared to the trawler and the purse-seine vessels. The canoe owners cannot afford to make higher capital investments due to low income as some of them are till today living under below poverty line. The purse-seine owners have invested in large size vessels as compared to the trawler and the motorized canoe owners. Purse-seine fishing gear helps to capture more fish catch as compared to the trawl net used for trawlers and gill net used in motorized canoes. It is concluded from the findings that there is a variation and significant difference for capital investments, operating costs, fixed costs, earnings, catch and profits among different categories of fishing crafts across districts for motorized canoes and jetties for mechanized vessels i.e trawlers and purse-seiners.

4. The fishermen owning motorized canoes are in the lowest rung of the social ladder. They save less due to less income as compared to the trawler and purse-seine owners. Government could motivate fishermen owning canoes and trawlers to invest in large size fishing crafts by providing them financial support. The performance of large size trawlers and purse-seine vessels is comparatively better in terms of labour productivity, fish catch, gross revenue, gross and net profit than the small and medium trawlers and medium purse-seine vessels. The efficiency of purse-seine vessels at Cutbona jetty was better than Malim and Vasco jetties. The efficiency of trawlers at Malim was better than Cutbona, Vasco and Chapora jetties. Fishing business has

helped to improve the socio-economic livelihood of fishermen owning purse-seine vessels to a great extent followed by trawler and canoe owners. The economic indicators have shown that it is advantageous for the fishermen to invest in large size fishing crafts. The fishing activity is capable of generating additional employment, augmenting income and improving the standard of living of the fishermen in Goa. Government's commitment to sustainable fishing policy will help this industry in supporting the national economy as well as nutritional security of the nation.

9.5 Contribution of the Study

1. The study has analyzed the trends of fish production (marine and inland) and marine exports in Goa which indicates that fish production is not showing a stable trend, but marine exports shows a positive increasing trend for the period 1990-2017. There is an increasing demand for fish consumption, increased investments in fishing crafts and demand for migrant labour from neighbouring states in the study area.

2. Due to motorization and mechanization of fishing business there is increase in capital invested across all three types of fishing crafts i.e. motorized canoes, trawlers and purse-seine vessels. However, there is increase in investments by fishermen on large size i.e. 65-75 feet purse-seine vessels and also increase in costs as well as profits. The capital investments by the fishermen has almost reached a threshold limit and if it increases further than sustaining profitability in the fishing business will be at stake. This will further increase illegal fishing practices leading to decline in marine diversity and if not controlled by government through strict measures and regulations it will severely affect the fishing business of the traditional fishermen in Goa.

3. The study makes contribution to the understanding of the capital investments and costs incurred by the fishermen on their fishing crafts and determinants of the fishermen income, earnings and savings from fishing business. The usage of Cobb Douglas production function in the multiple regression model yields results which imply that the independent variables namely; horsepower, fishing hours, fuel cost after subsidy and wages are statistically significant and should be leveraged further to increase the production of fish catch. One counter intuitive statistically significant finding is the negative relationship discovered between the number of fishing trips and the earnings from fish catch.

4. Government schemes are playing an important role in providing financial support to the fishermen on the increasing cost of fishing business. However, fishermen still expect better infrastructure facilities at the landing centres and more financial assistance from the government due to the increase in cost of capital investment, rising cost of fuel, increased number of fishing days and decline in marine fish catch. Government support in the form of schemes enhances the fishing business, but some schemes in the form of fuel subsidy adversely affect the environment causing depletion of marine resources. Government should promote subsidies, but at the same time enhance fishermen's commitment to sustainable fishing policies.

9.6 Scope for Further Research

This elaborate study on Goa's fishing industry organized in eight preceding chapters demonstrates that no academic research can specify the contours of Goa's fishing industry in its totality. Hence, it is proposed to suggest what could be the new areas for the future research on Goa's Fishing Industry. As this study has not been able to look into all the dimensions of fishing industry, there is wide scope for further research on this subject. The researchers could identify the research problem from the below unfolded backdrop.

Firstly the analysis of fish export processing firms could be studied through the marine exporters of Goa. The future researchers could study the cost, earnings and profit analysis as well as the problems faced by of non-motorized canoe owners in Goa. A study on brackish water and aquaculture fisheries could be taken up in future. A comparative analysis of marine exports; port wise, market wise and species wise across all the marine states by using secondary data could be researched. A study also could be carried on the fish trade agents operating at the various fish landing centers, retail and wholesale fish markets, and fish processing units of the fishing business in Goa. A socio-economic analysis of the fish vendors involved in marketing of fish catch could be studied. A socio-economic analysis of the traditional and mechanized sector could be examined. Lastly, the functioning of fishermen association and fisheries co-operatives in Goa could also be analyzed. A study on the impact of industrial pollution on the coastal fishery of Goa could be researched. An attempt can be made to study the impact of the world trade organization policies (WTO) on the fisheries sector. An immediate study could be undertaken on the issue of formalin in fish. It is hoped that this study will create further interest for research in this area.

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Appendices

Appendix I

Table 5A: Results of Independent Sample *t* test of the Average Capital Investment in Fixed Assets on Motorized Canoes with respect to Districts

Variables (Capital investments in fixed assets)	Districts		Independent sample *t*-test	
	North Goa	South Goa		
	Mean	Mean	*t*-value	Sig
Cost of canoe	95118_a **(32.57)**	114528_b **(34.71)**	-3.64	0.000**
Cost of net	162574_a **(55.68)**	180972_a **(54.85)**	-1.5	0.135
Cost of OBM petrol motor	33000 **(11.3)**	33000 **(10.03)**	Nil	Nil
Cost of safety equipment and ice box	1264_a **(0.43)**	1395_a **(0.42)**	-0.69	0.48
Total average capital investment	291956_a **100**	329895_b **100**	-2.56	0.012**

Note: **Variables significant at 5%, subscript a, a, represents no significant difference and a,b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of fixed asset, **Source:** Researcher's compilation from primary survey.

Table 5B: Results of Independent Sample *t*-test of Average Fixed Costs on Motorized Canoes as per Districts

Variables	Districts		Independent sample *t*-test	
	North Goa	South Goa		
	Mean	Mean	*t*-value	Sig
Depreciation on hull and OBM petrol motor	11238_a **(19.42)**	12928_b **(19.76)**	-3.06	0.003**
Depreciation on fishing gear(net)	40643_a **(70.25)**	45243_a **(69.76)**	-1.5	0.135
Depreciation on safety equipment and ice box	127_a **(0.21)**	140_a **(0.21)**	-0.69	0.486
Net license and contribution to society	1585_a **(2.73)**	1942_b **(2.96)**	-8.89	0.000**
Finance cost Interest on loan	4257_a **(7.35)**	5147_a **(7.87)**	-0.7	0.48
Total fixed costs	57850_a **100**	65400_b **100**	-2.05	0.042**

Note: **Variables significant at 5%, subscript a, a, represents no significant difference and a, b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of fixed asset, **Source:** Researcher's compilation from primary survey.

Table 5C: Operating Cost of Motorized Fishing Canoes against the Districts

Variables	Districts: North Goa Mean	Districts: South Goa Mean	Independent sample *t* test: *t*-value	Independent sample *t* test: Sig
Fuel costs after fuel subsidy	141749_a **(35.14)**	200317_b **(35.12)**	-4.87	0.000**
Wages to labour	135685_a **(33.64)**	195990_b **(34.36)**	-5.08	0.000**
Food and batta	25974_a **(6.44)**	37401_b **(6.56)**	-4.54	0.000**
Cost of Ice	8374_a **(2.07)**	10426_a **(1.83)**	-1.67	0.09*
Maintenance of canoe	17701_a **(4.38)**	22639_b **(3.97)**	-3.11	0.002**
Mending nets	35223_a **(8.73)**	41520_b **(7.28)**	-2.9	0.004**
Marketing	30674_a **(7.60)**	46725_b **(8.19)**	-5.53	0.000**
Costs of baskets	4926_a **(1.22)**	12369_b **(2.17)**	-5.89	0.000**
Miscellaneous expenses	3016_a **(0.74)**	2993_a **(0.52)**	0.15	0.88
Total operating cost	$\mathbf{403322_a}$ **(100)**	$\mathbf{570380_b}$ **(100)**	-5.55	0.000**

Note: ****Variables significant at 5%, subscript a, a, represents no significant difference and a, b means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of fixed asset, **Source: Researcher's compilation from primary survey.

Table 5D: Results of Independent sample *t* tests of Average Number of Fishing trips, Fishing days,Fishing hours of Motorized Fishing Canoes with respect to Districts for Entire Season (August-May)

Variables	Districts: North Goa Mean	Districts: South Goa Mean	Independent Samples *t* test: *t*-value	Independent Samples *t* test: Sig
Total Fishing trips	242_a	224_b	4.24	0.000**
Total Fishing days	235_a	219_b	4.07	0.000**
Total Fishing hours	777_a	794_a	-0.64	0.52

Note: ** Variables significant at 5% significance level, subscript "a, a," means no significant difference and "a, b, "means there is a significant difference, **Source:** Researcher's compilation from the primary survey.

Table 5E: Averages of Key Economic Indicators of Costs, Catch and Profit of Motorized Fishing Canoes for Entire Season (August-May)

Variables	Districts		Independent Samples Test	
	North Goa	South Goa		
	Mean	Mean	*t*-value	Sig
Total operating costs per trip (₹)	1714_a	2546_b	-6.14	0.000**
Total fixed costs per trip (₹)	247_a	293_b	-2.60	0.010**
Total costs per trip (₹)	1961_a	2839_b	-5.99	0.000**
Total catch for entire season **(in kgs)**	5143_a	7185_b	-6.12	0.000**
Catch per trip **(in kgs)**	22_a	32_b	-6.88	0.000**
Earnings per trip (₹)	2424_a	3511_b	-6.42	0.000**
Gross profit per trip (₹)	709_a	965_b	-6.38	0.000**
Net profit per trip (₹)	463_a	672_b	-6.29	0.000**

Note: ** Variables significant at 5% ,subscript" a, a" means no significant difference and "a, b" means there is a significant difference. **Source:** Researcher's compilation from the primary survey.

Table 6A : Results of ANOVA test of Average Cost of Capital Investment in Fixed Assets of Trawlers at Different Jetties

Variables	Jetties				ANOVA	
	Malim	Chapora	Vasco	Cutbona		
	Mean(Rs)	Mean(Rs)	Mean(Rs)	Mean(Rs)	*F* statistics	Sig
Hull of boat	1188183_a	563700_b	$733421_{b,c}$	$1020000_{a,c}$	3.11	0.03**
	(47.83)	**(40.08)**	**(43.83)**	**(48.17)**		
Engine of vessel	366708_a	184750_b	226842_b	$322206_{a,b}$	2.73	0.04**
	(14.76)	**(13.14)**	**(13.56)**	**(15.22)**		
Amount to modify vessel	156573_a	$80050_{b,c}$	90448_b	$137603_{a,c}$	2.12	0.001**
	(6.31)	**(5.69)**	**(5.41)**	**(6.50)**		
Reconditioning of vessel	653913_a	487500_a	550000_a	530769_a	1.31	0.28
	(26.33)	**(34.66)**	**(32.87)**	**(25.06)**		
Total cost of fishing gear	105400_a	$80400_{a,b}$	58500_b	94706_a	3.99	0.01**
	(4.24)	**(5.72)**	**(3.50)**	**(4.47)**		
Safety equipment	13183_a	10120_a	14150_a	12335_a	0.22	0.87
	(0.53)	**(0.72)**	**(0.85)**	**(0.58)**		
Total of mean	2483960	1406520	1673361	2117619		
	(100.00)	**(100.00)**	**(100.00)**	**(100.00)**		
Total average capital investment in fixed assets	$\mathbf{2333073_{a,c}}$	$\mathbf{1297653_b}$	$\mathbf{1455109_b}$	$\mathbf{1647409_{a,b}}$	**4.68**	**0.005****

Note: **Variables significant at 5%,a,a , b,b, means there is no significant difference and a,b, ac, ab,bc means there is significant difference. Figures in parenthesis represent proportion of mean percentage. **Source**: Researcher's compilation from primary survey

Table 6 B: Total Averages of Fixed Costs on Trawlers with respect to Jetties

Fixed costs	Jetties				ANOVA	
	Malim	Chapora	Vasco	Cutbona		
	Mean	Mean	Mean	Mean	*F*-value	Sig
Depreciation on hull and engine	88419_a	53953_a	54404_a	63208_a	2.172	0.08
	(22.67)	**(61.95)**	**(34.32)**	**(28.44)**		
Depreciation on modification of vessel	8091_a	5172_a	4474_a	5366_a	2.896	0.02**
	(2.07)	**(5.94)**	**(2.82)**	**(2.41)**		
Depreciation on Reconditioning	17354_a	11700_a	10421.05_a	12176_a	1.656	0.17
	(4.45)	**(13.43)**	**(6.57)**	**(5.48)**		
Depreciation on fishing gear (net)	15810_a	$12060_{a,b}$	8775_b	$14206_{a,b}$	3.617	0.01**
	(4.05)	**(13.85)**	**(5.54)**	**(6.39)**		
Depreciation on safety equipment	2579_a	2012_a	3354_a	3744_a	0.496	0.73
	(0.66)	**(2.31)**	**(2.11)**	**(1.68)**		
Insurance on vessel and crew	68602_a	610_b	38481_b	$48801_{ab,}$	5.11	0.01**
	(17.59)	**(0.70)**	**(24.27)**	**21.95)**		
Trawler and net license fee, membership contribution and maintenance of jetty	**1735_a**	**1580_a**	**1600_a**	**3901_a**	0.934	0.44
	(0.44)	**(1.81)**	**(1.01)**	**(1.76)**		
Finance costs Interests on loan	187500	Nil	37000	70875	13.31	0.01**
	(48.07)	Nil	**(23.34)**	**(31.89)**		
Total mean	**390090**	**87088**	**158509**	**237639**		
	(100.00)	**(100.00)**	**(100.00)**	**(100.00)**		
Total average of fixed costs	**183036_a**	**93992_b**	**$119103_{a,b}$**	**$154986_{a,b}$**	**3.50**	**0.01****

Note: **Variables significant at 5%,a,a , b,b, means there is no significant difference and a,b, ac, ab,bc means there is significant difference. Figures in parenthesis represent proportion of mean percentage. **Source**: Researcher's compilation from primary survey

Table 6C: Operating Costs of Trawlers Jetty-wise for Entire Season (Aug to May)

Variables	Jetties				ANOVA	
	Malim	Chapora	Vasco	Cutbona		
	Mean(Rs)	Mean(Rs)	Mean(Rs)	Mean(Rs)	*F*- value	Sig.
Fuel cost	1491470_{a}	598244_{b}	$1150244_{a,b}$	1265434_{a}	5.92	0.00
	(45.18)	**(41.13)**	**(50.79)**	**(46.16)**		
Wages	985371_{a}	446750_{b}	575204_{b}	$820886_{a,c}$	14.08	0.00
	(29.85)	**(30.72)**	**(25.40)**	**(29.94)**		
Ration	153564_{a}	74850_{b}	80793_{b}	$123038_{a,c}$	14.63	0.00
	(4.65)	**(5.15)**	**(3.57)**	**(4.49)**		
Cost of Ice	261954_{a}	71100_{b}	$158811_{b,c}$	$211255_{a,c,d}$	11.23	0.00
	(7.93)	**(4.89)**	**(7.01)**	**(7.71)**		
Maintenance	167693_{a}	113000_{b}	98263_{b}	110000_{b}	11.07	0.00
	(5.08)	**(7.77)**	**(4.34)**	**(4.01)**		
Mending of nets	106146_{a}	93300_{a}	79632_{a}	93481_{a}	2.31	0.06
	(3.22)	**(6.41)**	**(3.52)**	**(3.41)**		
Oil and Lubricants	44505_{a}	38891_{a}	45427_{a}	40044_{a}	1.11	0.35
	(1.35)	**(2.67)**	**(2.01)**	**(1.46)**		
Marketing and transportation	82671_{a}	12333_{a}	70997_{a}	71863_{a}	2.02	0.10
	(2.50)	**(0.85)**	**(3.14)**	**(2.62)**		
Miscellaneous expenses	8107_{a}	5940_{a}	5167_{a}	5697_{a}	2.77	0.03
	(0.25)	**(0.41)**	**(0.23)**	**(0.21)**		
Total mean	**3301481**	**1454408**	**2264538**	**2741698**	-	-
	(100.00)	**(100.00)**	**(100.00)**	**(100.00)**		
Total average operating costs	$\mathbf{3253944_{a}}$	$\mathbf{1397808_{b}}$	$\mathbf{2283294_{b,c}}$	$\mathbf{2455473_{a,b}}$	**8.536**	**0.00**

Source: Researcher's compilation from primary survey, Figures in parenthesis indicates percentages.

Table 6D: Results of ANOVA test of Number of trips, Fishing days, Fishing hours of Trawlers with respect to Jetties for Entire Season (August-May)

Variables	Jetties				ANOVA	
	Malim	Chapora	Vasco	Cutbona		
	Mean	Mean	Mean	Mean	F- value	Sig
Total trips	64_{a}	57_{a}	100_{a}	65_{b}	5.02	0.00**
Total fishing days	216_{a}	173_{b}	210_{a}	219_{a}	6.05	0.00**
Total fishing hours	1134_{a}	800_{b}	922_{b}	$1068_{a,b}$	5.1	0.00**

Source: Researcher's compilation from primary survey.

Table 6 E: Averages of Costs, Earnings and Profit of Trawlers Jetty-wise for Entire Season (August to May)

Variables	Jetties				ANOVA	
	Malim	Chapora	Vasco	Cutbona		
	Mean	Mean	Mean	Mean	*F* - value	Sig
Operating cost per trip (₹)	79296_a	21172_b	31987_b	43269_b	13.71	0.00**
Total fixed cost per trip (₹)	4834_a	1551_b	1712_b	$3080_{a,b}$	6.53	0.00**
Total cost per trip (₹)	84130_a	22723_b	33699_b	46348_b	13.57	0.00**
Total catch for a season **(in kgs)**	40269_a	19919_b	21976_b	$31391_{a,b}$	7.57	0.00**
Catch per trip (in kgs)	954_a	312_b	354_b	$653_{a,b}$	7.28	0.00**
Earnings per trip (₹)	104547_a	31053_b	47497_b	$72049_{a,b}$	8.7	0.00**
Gross profit per trip (₹)	24916_a	7545_b	8988_b	13957_b	9.31	0.00**
Net profit per trip (₹)	20082_a	5994_b	7276_b	10877_b	7.94	0.00**

Note: ** Variable significant at 5% significance level, subscript "a,a,a" means no significant difference and "a,b,c" means there is significant difference. **Source:** Researcher's compilation from Primary survey.

Table 7A: Results of ANOVA test of the Average Cost of Capital Investment in Fixed Assets of Purse-seine vessels with respect to the Jetties

Variables	Jetties			ANOVA	
	Malim	Vasco	Cutbona		
	Mean	Mean	Mean	F-value	Sig
Hull	3706176_a (20.80)	2419853_a (33.92)	3518462_a (42.85)	1.778	0.17
Engine	1016176_a (5.70)	748235_a (10.49)	1024872_a (12.48)	1.086	0.34
Amount spent to modify the vessel	398235_a (2.23)	329853_a (4.62)	428205_a (5.22)	0.672	0.51
Reconditioning	10000001 (56.12)	1437500_a (20.15)	510000_b (6.21)	5.93	0.01**
Total cost of all nets	$2414706_{a,b}$ (13.55)	1964706_a (27.54)	2474359_b (30.14)	4.104	0.02**
Own money safety equip	43080_a (0.24)	65835_a (0.92)	44397_a (0.54)	0.176	0.83
Own money purseine block	240000_a (1.35)	167059_a (2.34)	209923_a (2.56)	2.1	0.13
Total mean	**17818374 (100.00)**	**7133041 (100.00)**	**8210218 (100.00)**		
Total capital investments	**7877197_a**	**6372012_a**	**7765603_a**	**1.219**	**0.30**

Note: **Variables significant at 5%, subscripts a, b, c represents no significant difference and a,a,b and a, b,c means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of fixed asset, **Source:** Researcher's compilation from primary survey.

Table 7B: Total Fixed costs of Purse-seiners Jetty-wise using ANOVA

Variables (Fixed costs)	Jetties			ANOVA	
	Malim	Vasco	Cutbona		
	Mean	Mean	Mean	F	Sig
Depreciation on hull and engine	472236_a	316809_a	454333_a	1.77	0.17
	(32.87)	**(28.49)**	**(27.52)**		
Depreciation on amt to modify vessel	11947_a	9896_a	12846_a	0.67	0.51
	(0.83)	**(0.89)**	**(0.78)**		
Depreciation on reconditioning	1765_a	20294_b	1962_a	12.91	0.00**
	(0.12)	**(1.83)**	**(0.12)**		
Depreciation on purseine net	$241471_{a,b}$	196471_a	247436_b	4.10	0.02**
	(16.81)	**(17.67)**	**(14.99)**		
Depreciation on purseine block	24000_a	16706_a	20992_a	2.10	1.30
	(1.67)	**(1.50)**	**(1.27)**		
Depreciation on safety and other equipment	2154_a	3292_b	2220_a	6.52	0.003**
	(0.15)	**(0.30)**	**(0.13)**		
Insurance on vessel	111887_a	96525_a	117759_a	1.63	0.20
	(7.79)	**(8.68)**	**(7.13)**		
License fee and contribution for maintenance of jetty	3625_a	3114_b	6265_b	18.33	0.00**
	(0.25)	**(0.28)**	**(0.38)**		
Finance costs Interest paid on loan	$283750_{a,b}$	224400_a	393500_b	5.12	0.02**
	(19.75)	**(20.18)**	**(23.84)**		
Total of average of fixed costs	1436585	1111907	1650813		
	(100.00)	**(100.00)**	**(100.00)**		
Average of total fixed costs	$\mathbf{923048_a}$	$\mathbf{703674_a}$	$\mathbf{909204_a}$	**1.524**	**0.22**

Note: ****Variables significant at 5%, subscripts a, b, c represents no significant difference and a,a,b and a, b,c means there is a significant difference, Figures in (parenthesis) represents the proportion of mean percentage to the total of average of fixed asset, **Source: Researcher's compilation from primary survey

Table 7 C: Jetty-wise Operating Costs of Purse-seiners

Variables	Jetties			ANOVA	
	Malim	Vasco	Cutbona		
	Mean	Mean	Mean	*F*	Sig
Fuel costs after diesel VAT subsidy	2552643_a **(41.86)**	2329658_a **(39.68)**	2594613_a **(35.71)**	0.55	0.57
Wages to labour	2116226_a **(34.71)**	2174647_a **(37.04)**	2624628_b **(36.12)**	4.12	0.02**
Food , batta and (Ration)	403813_a **(6.62)**	395406_a **(6.74)**	441153_a **(6.07)**	1.40	0.25
Cost of Ice	415566_a **(6.82)**	451015_a **(7.68)**	671105_b **(9.24)**	18.40	0.00**
Regular maintenance	185419_a **(3.04)**	164706_a **(2.81)**	203069_a **(2.79)**	2.44	0.09
Mending of nets	204260_a **(3.35)**	166588_a **(2.84)**	327717_b **(4.51)**	8.82	0.00**
Oil and Lubricants	67432_a **(1.11)**	76638_a **(1.31)**	73630_a **(1.01)**	1.03	0.36
Marketing and transportation	142386_a **(2.34)**	103137_a **(1.76)**	320093_b **(4.41)**	20.39	0.00**
Miscellaneous expenses	9527_a **(0.16)**	8637_a **(0.14)**	10361_a **(0.17)**	0.51	0.60
Total of Average of Operating costs	6097172 **(100.00)**	5870332 **(100.00)**	7266269 **(100.00)**		
Average of Total operating costs	$\mathbf{6063770_{a,b}}$	$\mathbf{5809550_a}$	$\mathbf{7274061_b}$	4.63	0.01**

Note: ** Variable significant at 5% significance level, a, a, a means no significant difference and a, b, c means there is significant difference. Figures in (parenthesis) indicate percentages to the total of average of operating costs, **Source:** Researcher's compilation from Primary survey.

Table 7D: Results of ANOVA tests of Average Number of trips, Fishing days, Fishing hours for Purse-seine Vessels with respect to Jetties for Entire season (August-May)

Variables	Jetties			ANOVA	
	Malim	Vasco	Cutbona		
	Mean	Mean	Mean	F	Sig.
Total fishing trips	38_{a}	56_{b}	$42_{a,b}$	3.557	0.03**
Total fishing days	220_{a}	216_{a}	224_{a}	1.294	0.28
Total fishing hours	932_{a}	907_{a}	1127_{b}	10.914	0.00**

Note: ****Variables significant at 5%, **subscripts "a, a, a" represents no significant difference and a, b means there is a significant difference, **Source:** Researcher's compilation from primary survey.

Table 7 E: Averages of Costs, Earnings and Profit of Purse-seine Vessels Jetty-wise for Entire Season (August to May)

Variables	Jetties			ANOVA	
	Malim	Vasco	Cutbona		
	Mean	Mean	Mean	F	Sig.
Total operating costs per trip **(₹)**	$160348_{a,b}$	122997_{a}	178215_{b}	6.574	0.002**
Total fixed costs per trip **(₹)**	24857_{a}	16034_{a}	23134_{a}	1.987	0.14
Total costs per trip **(₹)**	$185205_{a,b}$	139031_{a}	201349_{b}	6.574	0.002**
Total catch for entire season **(in kgs)**	68506_{a}	49134_{a}	130509_{b}	34.631	0.00**
Catch per trip **(in kgs)**	1820_{a}	990_{a}	3190_{b}	36.47	0.00**
Earnings per trip **(₹)**	$207423_{a,b}$	151623_{a}	254770_{b}	11.974	0.00**
Gross profit per trip **(₹)**	47076_{a}	28627_{a}	76556_{b}	24.779	0.00**
Net profit per trip **(₹)**	22218_{a}	12593_{a}	54427_{b}	28.467	0.00**

Note: ** Variable significant at 5% significance level, subscript" a, a, a" means no significant difference and "a, b" means there is significant difference. **Source:** Researcher's compilation from Primary survey.

Appendix II

INTERVIEW SCHEDULE I

FOR TRADITIONAL MOTORIZED CANOE OWNERS

I Ms. Sanchiliana Faria Researcher, Associate Prof. from MES College of Arts & Commerce, Zuarinagar, Goa, registered as research scholar for P.h.D in Commerce, Goa University, under the guidance of Dr. Manoj S. Kamat, Principal, D.P.M's Shree Mallikarjun College, Canacona, Goa. I am working on the Ph.D. topic on "**An Analysis of the Commercial Aspects of the Fishing Industry of Goa".** I would like to assure your good self that the findings of this survey will be strictly used for academic purpose only and carried on by me personally. Your valuable time and efforts are highly appreciated. I sincerely thank you for your precious time in answering my interview schedule.

Section A: PERSONAL DETAILS/PROFILES OF CANOE OWNERS.
Contact No: ________________
VRC No___________________ Name of Canoe_________________

Name ……………………………………………………………………(Optional)

1. Gender: Male ☐ Female ☐
2. Age (years)______________________
2a. Size of family members____________
3. Educational Qualification: Illiterate ___ Primary____ Secondary ___SSC__
HSSC ____ Graduate ____Diploma_____ Any other ____________
4. Which district you belong to? North Goa ______ South Goa _______

5. Which coastal talukas do you belong? Which talukas is the fishing ramp situated ?

Tiswadi	Bardez	Pernem	Mormugao	Salcete	Canacona
Ramp	Ramp	Ramp	Ramp	Ramp	Ramp

5. a Which caste you belong to? SC/ ST/ OBC/ General

6. Do you belong to Above poverty line or Below poverty line? APL___BPL __

7. Whether fishing is primary (main) or secondary occupation ? Primary ☐ Secondary ☐

8. Number of years of experience in fishing business? In years _____________

9. Number of family members involved in fishing? _________

10. Is fishing your major source of income ? Yes ☐ No ☐

11.What are savings, and liabilities per annum from fishing activities?

Fishing Business	11.a Income per year from more than one canoe	11b. Savings per year from fishing	11.c.Liabilities per year from fishing	11.d. Household expenditure p.a

12. What is your Secondary occupation/business ?
1. Water sports____ 2. Net making____ 3. Net repairing____4. Agricultural and allied activities____
5. Service ____ 6.Trade ____ 7. Retailer _____ 8. Any other activity ______
13. What are savings, and liabilities per annum from secondary business ?

Secondary Business	13.a.Income per year	13.b.Savings (Rs)	13.c.Liabilities (Rs)

SECTION B: INFORMATION ON CHARACTERISTICS OF CANOES & PARTICULARS OF CAPITAL INVESTMENTS ON CANOES

14. Total number of canoes you own ________

15. Nature of ownership?
1. Sole Proprietorship (owned)_____ 2. Partnership _____ 3. Leased/Rental _____ 4. Others (pls specify)_____

16. What is the mode of acquisition of the canoe?
16.a. Inherited _____ 16.b. Purchased _______ 16.c.Entered into partnership_______

17: DETAILS ON SPECIFICATION OF MOTORISED CANOES & PARTICULARS UNDER CAPITAL INVESTMENTS ON COST OF CANOES.

Specify the details of only one canoe

Sr.No	Parameters
17. a	Type of canoe? Wooden ☐ Fibre Reinforced Plastic (FRP) ☐
17. b	Cost of Canoe without motor and net Rs_________________________
17. c	Cost of all nets Rs______________ Mesh Size- _______________
17. d	Cost of one petrol/kerosene outboard motor Rs__
17. e	Cost of ice boxes,life saving jackets/life buoys(safety equipment) Rs___
17. f	Total capital investment Rs________
17. g	Horsepower of motor_______
17. h	Size of canoe___feet/metres (Length x Breadth x Depth (in meters/ft) of one canoe)
17. i	Year of purchase of new canoe:Year __________
17 .j	Expected life of new canoe in years:___________
17. k	How old was canoe when purchased (old boat purchased)-Year:__________
17. l	What is Expected life of old canoe in years:_______

SECTION C: INFORMATION ON LABOUR EMPLOYED

18. Number of employees employed from Goa and other states
18a.Number of employees from Goa_______ 18b.Number of migrant employees __________
18c.Grand total employees employed_______________

19. Do you provide reimbursement of medical expenses to the labour? Yes ☐ No ☐

20. Have you made temporary Identity card for your employees? Yes ☐ No ☐

21. Do you provide accommodation for your employees Yes ☐ No ☐

SECTION D: INFORMATION ON MARKETING OF FISH

22. Disposition of marine fish catch ?

22a.Marketing(wholesale)	22b.Sale by fly members	22c.Sundried	22d.Salted	22.e.Manure

23. Where do you sell the fish? (Rank the options 1-4)
23a.Landing point ___23b.Sell in Local market__ 23c.Sell to agents __ 23d.Any other Pls specify____

SECTION E: PARTICULARS UNDER FIXED COST FOR CANOE

24.Fixed cost details of Canoes

Sr.No	Nature of fixed costs	Rs (p.a)
24.a	Net licence fee	Rs
24.b	Fishing canoe fee paid to Government per annum	Rs

Section F: INFORMATION ON VARIABLE COSTS/OPERATING COSTS AND EARNINGS ON CANOES

25.Variable Costs and Earnings from Motorized Fishing Canoes.

25	Variable costs	Total
25. a	Total number of trips	
25. b	Time for fishing per trip (Hours)	
25. c	Total number of fishing days	
25. d	Cost of Fuel p.m	Total Rs
25. e.	Mending of nets p.a	Total Rs
25. f	Cost of ice p.m	Total Rs
25. g	Wages for employees p.m	Total Rs
25 .h	Food, water and other expenses for crew p.m	Total Rs
25. i	Marketing and transportation p.m	Total Rs
25. j	Maintenance of canoe, motor, gillnet, equipment ,oil painting , servicing per year p.a	Total Rs
25. k	Cost of baskets and ropes p.m	Total Rs
25. l	Miscellaneous expenses p.m	Total Rs
	Total operating costs (Aug to May)	**Total Rs**

25.m. Qty of fish catch in kgs p.m _______________

25.n. Earnings from fish catch p.m Rs. ___________

Section G: SOURCES OF FINANCE AND GOVERNMENT SUPPORT IN FORM OF SUBSIDIES AND OTHER WELFARE SCHEMES

26.Have you taken loan and subsidy under Government scheme ? Yes ____No______

Type of schemes	**Own money**	**Loan Money**	**Govt Subsidy**	**Totalcost (Own+loan +subsidy)**	**Rate of interest (%)**	**Number of years of loan Rs**	**Interest on loan p.a (Rs)**	**Loan paid Yes/No**
	Rs	**Rs**	**Rs**	**Rs**				
26. a. Cost of canoe								
26 .b. Cost of net								
26 .c. Cost of replaced motor								
26.d.Safety equipments								

27. Have you taken any other loan without government subsidy? Yes____ No ____
27. a. If Yes amount of loan Rs ________ 27. b. Purpose of loan _____

28. Sources of loan: Banks/ Fly members/ Relatives/ Friends/ Others pls specify__

28. a Rate of interest__ 28. b. Number of years of loan___28.c Interest paid p.a Rs___

29. Did you face difficulty in obtaining the loan for fishing activities? Yes / No
29.a.If yes,what difficulties you faced in obtaining the loan ? ____________________

30a. Loan taken for fishing and other purpose paid or no ? Yes/ No

31. Amount contributed to Corpus fund	31a.Petrol (fuel)subsidy received
Rs___________________________	Rs__________________________

32	Whether you contribute to Saving cum relief scheme (BPL Below poverty line) below 60 years	Yes	No
32. a	Amount contributed to the saving sum relief scheme	Rs	

33	Have you availed Group Accident insurance scheme for active fishermen(**BPL**)(18-70years)	**Yes**	**No**

34. Rate the satisfaction level regards subsidy availed by you mentioned below?
1= Very dissatisfied, 2= Dissatisfied, 3= Unsure, 4= Satisfied, 5= Very Satisfied

Type of Subsidy/Scheme/financial assistance	**Tick only the subsidy/ scheme availed by you from Govt.**		**Does the Govt. release the subsidy /scheme on time**		**Satisfaction level (Write Numbers)**
	Yes	**No**	**Yes**	**No**	
34 i. Financial Assistance for purchase of gill nets and accessories					
34 ii. Financial Assistance for construction/ purchase of new FRP canoe					
34iii.Financial assistance for replacement of old kerosene OBM to petrol outboard motor					
34 iv. Financial assistance for purchase of safety jackets and life buoys for the fishing vessels					
34 v. Interest subsidy on loans and allied activities(loan @4% upto Rs 5lakhs)					
34 vi Natural calamity relief to fishermen					

35.After availing the subsidy/schemes from the government, has it helped your fishing business? Yes ____________ No __________ If No give reason________________

36.Number of fishing equipment	**Before scheme**	**After scheme**
Canoes		
Motor		
Nets		

37.What is your perception as regards fuel (kerosene/Petrol)subsidy ? 1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree

Satisfaction level regarding fuel subsidy	**Write numbers**
37 a. Fuel subsidy helps to increase number of fishing days and cover more distance	
37 b. Fuel subsidy has helped to increase fishing operations & improve fish catch	
37 c. Fuel subsidy has helped to reduce cost of fishing operations, improve income & living conditions	

SECTION: H PARTICIPATION/ BENEFITS AVAILED FROM ASSOCIATION

38.Are you member of Association: Yes _______ No_________

39.Name of Association:____

40.Membership fee you pay per annum to the association Rs_____________

41.Do you attend the Annual General body Meeting of the Association? Yes _____ No_____ If yes, benefits of attending meeting pls specify______________

SECTION I: SATISFACTION LEVEL WITH MOTORISED FISHING BUSINESS

42. I am satisfied with the present canoe fishing business 1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Satisfaction level with present Mechanized business	**Write Number**
42 i. It is a source of livelihood and direct and indirect employment to labour	
42 ii. It has helped to improve the socio-economic conditions of the fishermen	
42 iii. Fishing is a profitable venture helps to improve earnings due to favourable price factor	
42 iv. I am happy to continue with the ancestral family business as I have future in this business	
42 v. I want my family/children to continue this fishing business	

SECTION J: PROBLEMS FACED BY FISHERMEN IN FISHING BUSINESS

43. Give your perception only regards the problems you face in canoe fishing business? **1= Strongly disagree, 2= Disagree, 3= Unsure, 4= Agree, 5= Strongly Agree**

	Write Number
43. i. Equipment's such as nets get damaged	
43. ii. Reduced catch and decline in returns per trip due to overutilization of fish resources and excess fishing efforts to catch fish	
43 iii. Costs of fishing per trip has increased	
43 iv. The middlemen agents take the major share of profit at the cost of fishermen	
43 v. Problems in repayment of loans due to low catch of fish and low profits	
43 vi. Increase in more number of crafts leads to more competition for fishing	
43 vii. Inadequate cold storage plants for preserving fish in our locality	
43 viii. Illegal fishing by way of Bull trawling/ Mini purse-seining /LED lights reduces fish yield	
43 ix. Inadequate fish meal processing plants in our locality due to which major income of Goa's fishermen moves out of Goa	
43. x. Fuel/petrol subsidy is not disbursed on time by the government	
43 .xi. Problems due to labour turnover/ labour absenteeism	

44. Have you availed training facilities in fishing from the Government or Association? Yes _____ No ____

45. Overall are you happy with the overall canoe fishing business and want to continue this fishing business? Yes _____ No______If No give reasons ________________________

46. Is the monitoring and surveillance system of government through patrol vessel regarding illegal fishing adequate? Yes___ No___If No give reason? __________________

47. What are your suggestions as regards fishing to policy makers ie Government?

____

Signature of fishermen owning canoe (Optional)_____________

Appendix III

INTERVIEW SCHEDULE II

FOR MECHANISED TRAWL BOAT OWNERS

I Ms. Sanchiliana Faria, Associate Prof. from MES College of Arts & Commerce, Zuarinagar, Goa, registered as research scholar for P.h.D in Commerce, Goa University, under the guidance of Dr. Manoj S. Kamat, Principal, D.P.M's Shree Mallikarjun College, Canacona, Goa. I am working on the Ph.D. topic on "**An Analysis of the Commercial Aspects of the Fishing Industry of Goa.** This interview schedule assesses the responses of the Mechanised Trawler owners of Goa (for objective 2 ie to study the commercial aspects with regards to cost and profitability, & objective 3 ie Government subsidy, facilities provided by Co-operative societies to the trawler owners). I would like to assure your good self that the findings of this survey will be strictly used for academic purpose only and carried on by me personally. Your valuable time and efforts are highly appreciated. I sincerely thank you for your precious time in answering my interview schedule.

SECTION A: PERSONAL INFORMATION

Contact ________________

VRC No ______________________________Name of Vessel____________________

Name ……………………………………………………………………………..(Optional)

1. Gender: Male ☐ Female ☐

2. Age (years)______________________

3. Educational Qualification: Illiterate ___ Primary____ Secondary ___ SSC___ HSSC ____ Graduate ____Diploma_____ Any other ____________

4. Which district you belong to?

1=North Goa ☐ 2= South Goa ☐

4.a Number of members in your family or size of family ?___

5. Which coastal talukas you belong to?

Tiswadi	Bardez	Mormugao	Salcete

5.a Which caste you belong to SC/ ST/ OBC/ General?

5.b. Which jetty you belong to ?

Malim	Chapora	Mormugao	Cutbona(Salcete)

6. Do you belong to Above poverty line or below poverty line? APL /BPL

7.Whether fishing is primary(main) or secondary occupation ?

Primary ☐ Secondary ☐

8. Number of years of experience in the fishery sector?(years) _______________

9. Number of your family members involved in fishing ? _________

10. Is fishing your major source of income? Yes ☐ No ☐

11. What are savings, and liabilities per annum of fishing?

Income per year	11.a. Income of more than one boat	11.b.Savings per year	11.c.Liabilities per year	11.d. Household expenditure p.a
Fishing Business				

12. What is your Secondary occupation/business? Kindly tick

Water sports/Net making /Net Repairing/Agricultural and allied activities / Service/ Trade & Profession/Retailer/Any other activity Pls specify ___________________________

13. What are savings, and liabilities per annum of Secondary business?

Secondary Business	13.a.Income per year	13.b.Savings per year	13.c.Liabilities per year

SECTION B: DETAILS ON SPECIFICATION AND PARTICULARS UNDER COST OF CAPITAL INVESTMENTS ON TRAWLERS

14. Total Number of vessels you own________

15. Nature of ownership?

Sole Proprietorship(owned)__ Partnership___Leased/Rental___ Others (Pls specify)______

15a. What is the mode of acquisition of the vessel?

Inherited ☐ Purchased ☐ Entered into partnership ☐

16.What are the methods of fishing used by mechanized vessels to catch fish? (give ranking 1-highest and 7 lowest)

Trawling___Gillnetting ___ Long lining__Traps___Cast net _ Drag Net_____

17. Specify the details of each of your boats/vessel

Sr. No	**Parameters**	**3-4 Cylinder**	**6 Cylinder**	**6 Cylinder**
A	**SPECIFICATION OF VESSEL**	(30-45ft)	(45-55ft)	(56-75)
a	Type of vessel(Wooden/ FRP/ Steel) 17a.Type of trawler i. Trawler ☐ ii. Purse-seiner ☐			
b	Length x Breadth x Depth of vessel 17b.Size of vessel____ feet, 17b i.Registration tonnage______			
c	Horsepower of engine of vessel			
d	17di.Year of purchase (newboat) Yr___ 17dii.Expected life of new vessel in years__			
e	17ei.How old was vessel when purchased (old boat purchased) -Year:____ 17eii.Expected life of vessel when purchased (Old boat)_______			
f	(Total Price of vessel without including Govt subsidy in Rs) 17fi.Hull- Rs______ 17 f ii.Engine- Rs _________ 17 f. iii. Amount spent to modify the vessel-Rs____ 17iv.Reconditioning Rs_____________			
g	17g.Type of Net :Trawl net, Purseine net, Gill net 17gi.Total cost of all nets :	Rs	Rs	Rs
h	17hi.Loan taken for entire vessel : Rs______ 17hii.Own money Rs________17hiii. Rate of interest___17hiv. Interest amount p.a Rs___			

17i. Number of years of loan ____

17j. Sources of loan : 17ji.Bank/ 17jii.Relatives/17jiii.Friends/ 17jiv.Agents/17jv.Any other_

17k. Loan taken Yes____No_______

17l.Loan paid : Yes / No

SECTION C: INFORMATION ON LABOUR EMPLOYED

Number of employees employed from Goa and other states?

18.Number of employees employed from Goa_____

19.Number of migrant employees ____

20. Do you provide reimbursement of medical expenses to the labour ?
a.Medical facilities provided Yes ___ No___
21. Do you provide death compensation to your employees ? Yes ___ No __
22. Have you made temporary Identity for your employees ? Yes ___ No__
23.Do you provide accommodation for your employees ? Yes ___ No __

SECTION D: INFORMATION ON MARKETING OF FISH
24. Disposition of marine fish catch ?
Marketing/ Sundried/ Salted/Miscellaneous including manure

25. Where do you sell the fish? (Rank the options 1-7)
25 a.Auction at landing point_____25.b.Sell to fish stall____25c. Sell to Retailer __25dSell to wholesale market______25e.Export out of state ___25f.Export out of the country___25g.Keep in cold storage___25hSell to fish processing plants_25.iSell to fish meal plants___25j.Any other Pls specify___

SECTION E: PARTICULARS UNDER FIXED COST
26. Fixed cost details of vessels per annum

Nature of fixed costs	**Rs. Per annum**
26a.Boat fee/Net licence fee/Survey fee	
26b.Insurance premium per vessel &equipment	
26c.Insurance premium paid on the safety of all employees per year	

SECTION F: INFORMATION ON VARIABLE COSTS& EARNINGS OF VESSEL SEASON WISE

	VARIABLE COSTS	**Total**
27a.	Total number of trips per month	
27b	Total number of fishing days	
27c	Total number of fishing hours	
27d	Cost of diesel/fuel per month	Rs
27e	Salary/wages for Ist Tandel p.m Rs________Batta________ Salary for 2nd Tandel p.m Rs________Batta________ Salary for Labour p.m Rs______and Batta per trip____per year	Rs
27f	Ration and drinking water per trip Rs_________	Rs
27g	Cost of ice per trip in tons Rs ____	Rs
27h	Maintenance of vessel, engine,equipments,painting and renovation	Rs
27i	Cost of mending nets per year	Rs
27j	Costs of lubricants including engine oil, grease p.m (Regular maintenance)	Rs
27k	Marketing and transportation per trip/logistics expenditure	Rs
27l	Any other expenses per year other than mentioned above	Rs
27m	**Total operating costs Aug to May**	**Rs**

27.n. Qty of fish catch in Kgs p.m_____ 27.o. Earnings from fish catch p.m Rs ___________

SECTION G: SOURCES OF FINANCE AND GOVERNMENT SUPPORT IN FORM OF SUBSIDIES AND OTHER WELFARE SCHEMES

28.Have you to availed subsidy under Government scheme? Yes______No______

Government Schemes for Fishermen	**Total(own money+govt subsidy)**	**Own money**	**Govt Subsidy**
Life jackets and life byoy	28a.Life jackets and life byoy Rs	28b. Life jackets and life byoy Rs	28c.Life jackets and life byoy Rs
Safety equipment's	28d.Safety equipment's Rs	28e.Safety equipment's Rs	28f.Safety equipment's Rs
Interest subsidy of 5 lakhs @4%	NA	NA	28g.Interest subsidy of 5 lakhs @4%
Insulated box	28h.Insulated box	28i.Insulate d box	28j.Insulated box Govt. subsidy

29. Did you face difficulty in obtaining the loan for fishing activities? Yes ___ No____

30.If yes, what difficulties you faced in obtaining the loan ? ____

31.What is the reimbursement of VAT on HSD Diesel subsidy you avail per vessel per year ?

31A.VAT subsidy received last year after deducting corpus fund Rs______________________	31B.Corpus fund Rs______________

32.What is your perception as regards) reimbursement of Diesel VAT subsidy ?
1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree

Perception regards fuel subsidy	**Write numbers**
32a.Fuel subsidy helps to increase number of fishing days and cover more distance	
32b.Fuel subsidy has helped to increase fishing operations & improve fish catch	
32c.Fuel subsidy has helped to reduce cost of fishing operations, improve income & living conditions	

		Yes	No
33	Whether you contribute to Saving cum relief scheme (BPL)below 60 years		
33a	Amount received from saving cum relief scheme	Rs__________	

34	**Do you contribute towards this scheme?**	**Yes**	**No**
34	General insurance scheme for active fishermen		
34a	Group Accident insurance scheme for active fishermen(**BPL**) (18-70years)		

35. Rate your satisfaction level regards subsidy/schemes availed mentioned below? 1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Type of Subsidy/Scheme	**Pls tick Yes/No only towards the subsidy/ scheme availed by you from Government**		**Does the Government release the subsidy /scheme/financial assistance on time**		**Satisfaction level (Write Numbers)**
	Yes	**No**	**Yes**	**No**	
35i. Reimbursement of VAT on HSD Diesel subsidy					
35ii.Safety equipment to the fishermen to purchase GPS, VHF,Search and Rescue beacon					
35iii.Financial assistance for purchase of safety jackets and life buoys for the fishing vessels					
35iv.Interest subsidy on loans and allied activities @4% upto 5 lakhs					
35v. Supply of Insulated boxes to Fisher Persons					
35vi.Natural calamity relief to fishermen					

36. After availing the subsidy/schemes from the Government, has it benefitted your business you to reduce cost, improve the profitability & performance of your overall fishing business?
Yes___No___ if No Specify the reason_________________________________

SECTION: H PARTICIPATION/ BENEFITS AVAILED FROM FISHERIES CO-OPERATIVE SOCIETY

37.Are you member of fisheries co-operative society : Yes _____ No_____
38.Name of fisheries society :____
39.Membership fee you pay per annum to the fisheries society Rs_____________
39a.Maintenance of jetty amount to the fisheries society paid p.a______
40.Do you attend the Annual General body Meeting of the society? Yes _____ No_____

If yes, benefits of attending meeting pls specify____

41. Satisfaction level towards the facilities availed by you from the Fisheries Co-operative society, 1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Benefits/Facilities availed from the Co-operative society at the jetties	**Yes/ No**	**If Yes, rank your satisfaction level**
Kindly tick by saying Yes/No only towards the benefits /facilities availed by you from the Co-operative societies		
41i. Availability of adequate ice plant and cold storage facilities at the jetty		
41ii. Availability of supply of water facilities at reasonable rates		
41iii. Provision to purchase fishing requisites and spare parts		
41iv. Facilities for repairs of the fishing boats and net mending facilities		
41v. Provision of fish selling outlet		
41vi. Provision of LPG, Groceries, consumer goods societies on at reasonable rates		
41vii. Availability of adequate space for landing of vessels		
41viii. Awareness of Government schemes		
41ix. Credit facilities (not cash) to purchase diesel from the society		
41x. Supply of Diesel at the jetty		

42 . What are the facilities you get from the government besides basic infrastructure facilities at the jetty?

____

43.Are you satisfied with the basic infrastructure facilities at the jetty? Yes / No
If No give reason____

SECTION I: SATISFACTION LEVEL WITH TRAWLING BUSINESS
1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Satisfaction level with present Mechanized fishing business	**Write the No**
44i.It is a source of livelihood and direct and indirect employment to labour	
44ii. It has helped to improve the socio-economic conditions of the fishermen	
44iii. Fishing is a profitable venture provided they get good catch and favourable price	
44iv. I am happy to continue with the ancestral family business	
44v.I want my children and future generation to continue this fishing business	

45.Are your children of the opinion to join this business? Yes / No .

If No give reason ____

SECTION J: PROBLEMS FACED BY FISHERMEN IN FISHING BUSINESS

46. Give your perception only regards the problems you face in mechanized fishing business? **1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree**

46. Give your perception only regards the problems you face in mechanized fishing business? **1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree**

	Write the No
46i.Damage to hull and fishing equipment such as GPS, fish finder, and nets	
46ii. Reduced fish catch due to excess fishing efforts and overexploitation resulting in low profits	
46iii. Costs of fishing per trip has increased	
46iv.The middlemen agents take the major share of profit at the cost of fishermen	
46v. Problems in repayment of loans due to low catch of fish and low profits	
46vi. Increase in size of mechanized vessels leading to competition for fishing	
46vii. Inadequate Infrastructure such as berthing of vessels and lack of cold storage facilities	
46viii. Problems due to illegal fishing such as mini-purse-seining, high speed boats, bull trawling , and led lights	
46ix. Illegal fishing by high speed boats, bull trawling and LED fishing by neighbouring states	
46x. Problems due to unavailability of labour	
46xi. Agents from other states sell frozen fish in the market which affects the business of local fishermen	
46xii. Lack of new Agents for competing in fish auction	

47.Is the government monitoring & surveillance system regarding illegal fishing adequate? Yes ___No____
If no give reason____

48. Have you availed training facilities in fishing provided by the Government? Yes____No____

49. Overall are you happy with the overall mechanized fishing business? Yes_____No___
If No reason____

50. Are you aware of Blue revolution through which Government plans attain conservation and sustainability? Yes______No_______________________________

51. Is the fuel subsidy given by the government adequate? Yes __ No__

52. What are your suggestions as regards fishing to policy makers ie Government?
____

Signature of Trawler owner (Optional)____________

Appendix IV

INTERVIEW SCHEDULE III

FOR MECHANISED PURSE-SEINE VESSEL OWNERS

I Ms. Sanchiliana Faria, Associate Prof. from MES College of Arts & Commerce, Zuarinagar, Goa, registered as research scholar for P.h.D in Commerce, Goa University, under the guidance of Dr. Manoj S. Kamat, Principal, D.P.M's Shree Mallikarjun College, Canacona, Goa. I am working on the Ph.D. topic on "**An Analysis of the Commercial Aspects of the Fishing Industry of Goa".** This interview schedule assesses the responses of the Mechanised Purse-seine vessel owners of Goa (for objective 2 ie to study the commercial aspects with regards to cost and profitability, & objective 3 ie Government subsidy, facilities provided by Co-operative societies to the purse-seine owners). I would like to assure your good self that the findings of this survey will be strictly used for academic purpose only and carried on by me personally. Your valuable time and efforts are highly appreciated. I sincerely thank you for your precious time in answering my interview schedule.

Section A: PERSONAL DETAILS/PROFILES OF PURSE-SEINE OWNERS.
Contact No: ________________
VRC No___________________ Name of Vessel_____________

Name ……………………………………………………………………(Optional)
1. Gender: Male ☐ Female ☐
2. Age (years)______________________
2. a Number of members in your family or size of family ?_______

3. Educational Qualification: Illiterate ___ Primary____ Secondary ___ SSC____HSSC ____ Graduate ____Diploma_____ Any other ____

4. Which district you belong to?

1=North Goa ☐ 2= South Goa ☐

4 a. Which coastal talukas you belong to?

Tiswadi	Bardez	Mormugao	Salcete

5. Which jetty you belong to ?

Malim	Mormugao	Cutbona(Salcete)

5.a Which caste you belong to SC/ ST/ OBC/ General?
6. Do you belong to Above poverty line or below poverty line? APL / BPL
7. Whether fishing is primary(main) or secondary occupation ? Primary ☐ Secondary ☐
8. Number of years of experience in the fishery sector? Years _______________
9. Number of your family members involved in fishing? _________
10. Is fishing your major source of income? Yes ☐ No ☐
11. What are savings, and liabilities per annum of fishing?

Income per year	11.a. Income of more than one boat	11.b.Savings per year from fishing	11.c.Liabilities per year from fishing	11.d. Household exp per annum
Fishing Business				

12. What is your Secondary occupation/business ? Kindly tick
Water sports/Net making /Net Repairing/Agricultural and allied activities / Service/ Trade & Profession/Retailer/Any other activity Pls specify _________________________

13. What are savings, and liabilities per annum of Secondary business?

	13.a.Income per year	13.b.Savings per year	13.c.Liabilities per year
Secondary Business			

SECTION B: INFORMATION ON INITIATION TO PURSE-SEINE FISHERY AND CHARACTERISTICS OF FISHING VESSELS

14. Total Number of vessels you own________

15. Nature of ownership?

Sole Proprietorship/(owned)__Partnership___Leased/Rental___ Others (Pls specify)____

16. What is the mode of acquisition of the vessel?

Inherited ___ Purchased ___ Entered into partnership___

17. Disposition of marine fish catch ?

17a.Marketing/ 17b.Sundried/ 17c.Salted/17d.Miscellaneous including manure

18. Where do you sell the fish? (Rank the options 1-7)

18a.Auction at landing point_____18.b.Sell to fish stall____18c. Sell to Retailer __18dSell to wholesale market______ 18e.Export out of state ___18f.Export out of the country___18g.Keep in cold storage___18hSell to fish processing plants_ 18.iSell to fish meal plants___18j.Any other Pls specify___

19.What are the methods of fishing used by mechanized vessels to catch fish? Purse-seining _

SECTION C: INFORMATION ON LABOUR EMPLOYED

20. Number of employees employed from Goa and other states?

20.aNumber of employees from Goa________ 20.b Number of migrant employees _______

21. Do you provide reimbursement of medical expenses to the labour ?

a.Medical facilities provided Yes ___ No__

22. Do you provide death compensation to your employees? Yes __ No ___

23. Have you made temporary Identity card for your employees? Yes ___No___

24.Do you provide accommodation for your employees ? Yes ___No ___

SECTION D: DETAILS ON SPECIFICATION OF VESSEL & PARTICULARS UNDER CAPITAL COST

25. Specify the details of each of your boats/vessel

Sr. No	**Parameters**	**4 cylinder**	**6 cylinder**	**6 cylinder**
A	**SPECIFICATION OF VESSEL (Size in feet)**	(45ft-55ft)	(45-55ft)	(56-75)
a	25.Type of vessel made of (Wooden/ FRP/Steel) 25a.Type of vessel i.Trawler ☐ ii.Purse-seiner ☐			
b	Length x Breadth x Depth of vessel 25b.Size of vessel_____________ feet 25bi.Registration tonnage___________			
25c	Horsepower of engine of vessel			
25d	25di.Year of purchase (new boat)Yr_______ 25dii.Expected life of vessel in years_______			
e	25ei.How old was vessel when purchased (old boat purchased) -Year:_________ 25eii.Expected life of vessel when purchased Old boat_______			
f	(Total Price of vessel without including Govt subsidy			

	in Rs) 25fi.Hull- Rs____________ 25fii.Engine- Rs __________ 25fiii.Amount spent to modify the vessel- Rs_________ 25fiv.Reconditioning Rs_____________			
g	25gType of Net: Purseine net 25gi.Total cost of all nets :	Rs	Rs	Rs
h	25hi.Loan taken for entire vessel : Rs______ 25hii.Own money Rs________ 25hiii. Rate of interest____ 25hiv. Interest amount p.a Rs_________			

25i. Number of years of loan ____
25j. Sources of loan : 25ji.Bank__ 25jii. Relatives__ 25jiii.Friends__ 25jiv.Agents__ 25jv.Any other__
25k. Loan taken Yes____No_______
25l.Loan paid : Yes / No

Section E: PARTICULARS UNDER FIXED COST

26. Fixed cost details of vessels per annum

Nature of fixed costs	**Rs. Per annum**
26a.Boat fee/Net licence fee/Survey fee	
26b.Insurance premium per vessel and equipment	
26c.Insurance premium paid on the safety of all employees per season	

SECTION F: INFORMATION ON VARIABLE COSTS& EARNINGS OF VESSEL FOR ENTIRE SEASON WISE AUGUST TO MAY

27.Variable Costs and Earnings of Vessel Season wise.

	VARIABLE COSTS	**Total**
27a.	Total number of trips per month	
27b	Total number of fishing days	
27c	Total number of fishing hours	
27d	Cost of diesel/fuel per month	Rs
27e	Salary/wages for Ist Tandel p.mRs________Batta________ Salary for 2^{nd}Tandel p.m Rs________Batta________ Salary of Maskman p.m Rs________Batta ________ Salary of Aryaman p.m_____Batta per trip_____ Salary for Labour p.m Rs______and Batta per trip____per year	Rs
27f	Ration and drinking water per trip Rs_________	Rs
27g	Cost of ice per trip in tons Rs ____	Rs
27h	Maintenance of vessel, engine,equipments,painting and renovation	Rs
27i	Cost of mending nets per year	Rs
27j	Costs of lubricants including engine oil, grease p.m (Regular maintenance)	Rs
27k	Marketing and transportation per trip/logistics expenditure	Rs
27L	Any other expenses per year other than mentioned above	Rs
27m	Qty of catch in Kgs/tons per month	Rs
27n	Earnings from fish catch per month	Rs
27.o	Total operating costs Aug to May	Rs

SECTION G: GOVERNMENT SUPPORT IN THE FORM OF INFRASTRUCTURE FACILITIES/SUBSIDIES AND OTHER WELFARE SCHEMES: Sources of Finance

28.Have you taken loan under any Government scheme to avail subsidy?

Yes ______No______

	Total(own money+govt subsidy)	**Own money**	**Govt Subsidy**
Life jackets and life byoy	28a.Life jackets and life byoy Rs	28b. Life jackets and life byoy Rs	28c.Life jackets and life byoy Rs
Purse-seine block	28d. Purse-seine block Rs	28e. Purse-seine block Rs	28f. Purse-seine block Rs
Safety equipment's	28g.Safety equipment's Rs	28h.Safety equipment's Rs	28i.Safety equipment's Rs
Interest subsidy of 5 lakhs @4%	NA	NA	28j.Interest subsidy of 5 lakhs @4%
Insulated box	28k.Insulated box	28L.Insulated box	28m.Insulated box govt.subsidy

29. Did you face difficulty in obtaining the loan for fishing activities? Yes ___ No____

30.If yes, what difficulties you faced in obtaining the loan ? ____

31.What is the reimbursement of VAT on HSD Diesel subsidy you avail per vessel per year ?

31. Diesel subsidy VAT reimbursement after deducting corpus fund Rs___________________	31a.Corpus fund Rs__________

32.What is your perception as regards) reimbursement of Diesel VAT subsidy ?
1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree

Perception regards fuel subsidy	**Write numbers**
32a.Fuel subsidy helps to increase number of fishing days and cover more distance	
32b.Fuel subsidy has helped to increase fishing operations & improve fish catch	
32c.Fuel subsidy has helped to reduce cost of fishing operations, improve income and living conditions	

33	Whether you contribute to Saving cum relief scheme (BPL) below 60 years	Yes	No

	Do you contribute towards this schemes?	**Yes**	**No**
34	General insurance scheme for active fishermen		
34a	Group Accident insurance scheme for active fishermen(**BPL**) (18-70years)		

35. Rate your satisfaction level regards subsidy/schemes availed mentioned below? **1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied**

Type of Subsidy/Scheme	**Pls tick Yes/No only towards the subsidy/ scheme availed by you from Government**		**Does the Government release the subsidy /scheme/financial assistance on time**		**Satisfaction level (Write Numbers)**
	Yes	**No**	**Yes**	**No**	
35i. Reimbursement of VAT on HSD Diesel subsidy					
35ii. Safety equipment to the fishermen to purchase GPS, VHF, Search and Rescue beacon					
35iii. Financial assistance for purchase of safety jackets and life buoys for the fishing vessels					
35iv. Interest subsidy on loans and allied activities @4% upto 5 lakhs					
35v. Supply of Insulated boxes to Fisher Persons					
35vi.Supply of purseine block					
35vii.Natural calamity relief to fishermen					

36. After availing the subsidy/schemes from the Government , has it benefitted your business you to reduce cost, improve the profitability & performance of your overall fishing business?
Yes___No___ if No Specify the reason_________________________________

SECTION: H PARTICIPATION/ BENEFITS AVAILED FROM CO-OPERATIVE SOCIETY

37.Are you member of co-operative society : Yes _____ No_____
38.Name of society :____
39.Membership fee you pay per annum to the society Rs___________
39a.Maintenance of jetty amt paid p.a______
40.Do you attend the Annual General body meeting of the society? Yes ___ No_____
If yes, benefits of attending meeting pls specify__________________________________

41. Satisfaction level towards the facilities availed by you from the Co-operative society. 1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Benefits/Facilities availed from the Co-operative society at the jetties			**If Yes, rank your satisfaction level (pls write number)**
Kindly tick by saying Yes/No only towards the benefits /facilities availed by you from the Co-operative societies	**Yes**	**No**	
41i.Availability of adequate ice plant and cold storage facilities at the jetty			
41ii.Availability of supply of water facilities at reasonable rates			
41iii. Availability of fishing requisites and spare parts			
41ivFacilities for repairs of the fishing boats and nets			
41v.Provision of fish selling outlet			
41vi.Provision of LPG, Groceries, consumer goods societies on whole sale /retail basis at reasonable rates			
41vii. Availability of adequate space for landing of vessels			
41viii.Awareness of Government schemes			
41ix. Credit facilities (not cash) to purchase diesel from the society			
41x.Supply of Diesel at the jetty			

42 . What are the facilities you get from the government besides basic infrastructure facilities at the jetty?

____

43.Are you satisfied with the basic infrastructure facilities at the jetty? Yes / No
If No give reason____

SECTION I: SATISFACTION LEVEL WITH MECHANISED PURSE-SEINING BUSINESS
44. I am satisfied with the present mechanized fishing business.
1= Very dissatisfied, 2= Dissatisfied, 3=Unsure, 4= Satisfied, 5=Very Satisfied

Satisfaction level with present Mechanized fishing business	**Write the No**
44i.It is a source of livelihood and direct and indirect employment to labour	
44ii. It has helped to improve the socio-economic conditions of the fishermen	
44iii. Fishing is a profitable venture provided they get good catch and favourable price	
44iv. I am happy to continue with the ancestral family business	
44v.I want my children and future generation to continue this fishing business	

45.Are your children of the opinion to join this business? Yes / No
If No give reason________________

SECTION J: PROBLEMS FACED BY FISHERMEN IN FISHING BUSINESS

46. Give your perception only regards the problems you face in mechanized fishing business? **1= Strongly disagree, 2=, Disagree 3=Unsure, 4=Agree, 5= Strongly Agree**

	Write the No
46i.Damage to hull and fishing equipment such as GPS, fish finder, and nets	
46ii. Reduced fish catch due to excess fishing efforts and overexploitation resulting in low profits	
46iii. Costs of fishing per trip has increased	
46iv.The middlemen agents take the major share of profit at the cost of fishermen	
46v. Problems in repayment of loans due to low catch of fish and low profits	
46vi. Increase in size of mechanized vessels leading to competition for fishing	
46vii. Inadequate Infrastructure such as berthing of vessels and lack of cold storage facilities	
46viii. Problems due to illegal fishing such as mini-purse-seining, high speed boats, bull trawling , and led lights	
46ix. Illegal fishing by high speed boats, bull trawling and LED fishing by neighbouring states	
46x. Problems due to unavailability of labour	
46xi. Agents from other states sell frozen fish in the market which affects the business of local fishermen	
46xii. Lack of new Agents for competing in fish auction	

47.Is the monitoring & surveillance system regarding illegal fishing adequate? Yes___No____If no give reason______________________________________
48. Have you availed training facilities in fishing provided by the Government? Yes____No____
49. Overall are you happy with the overall mechanized fishing business? Yes_____No___If No reason_______
50. Are you aware of Blue revolution through which Government plans attain conservation and sustainability? Yes______No______
51. Is the fuel subsidy given by the government adequate? Yes __ No
52. What are your suggestions as regards fishing to policy makers ie to the Government?____

Signature of Purse-seine owner (Optional)____________

26

Role of Government through Subsidies and Schemes for the Welfare of Fishing Community in Goa

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Abstract

In this study an attempt is made to evaluate the benefits of each subsidy/schemeprovided by the Government of Goa for the welfare of fishing community from 2012-16 with the help of percentage analysis by using secondary data. The analysis of the subsidies/ schemes showed that maximum beneficiaries have availed fuel subsidy and general insurance scheme and the least availed scheme is the National Welfare fundfor Development of Fishermen Village Housing.The percentage of government grant to total GSDP towards the fisheries subsidies in Goa has increased for the last 4years. Policy intervention is necessary to ensure monitoring of the subsidies provided to the fishermen to ensure long term sustainability as well as nutritional security.

Keywords: Subsidies, Centrally and State sponsored schemes, Blue Revolution.

Introduction

Fisheries subsidies are money/ services from government used to support fishing industry. The top three subsidizing countries of the world are Japan 4.5 billion $, China 4.5 billion $ and US 4.098 $ followed by the European Union. Every year $35 billion in subsidies are invested into fisheries industries around the world and total global revenue from fishing worldwide is 90 $. The three main types of subsidies are capacity enhancing subsidies, beneficial subsidies and ambiguous subsidies. Capacity enhancing subsidies allow fishermen to fish more such as tax breaks on fuel, purchase bigger boats engines; improved gear but they decrease fish stock due to overexploitation. Beneficial subsidies help to create sustainability of the fish stocks such as fisheries management, research & development and regulation enforcement. Amoiguous subsidies have both effects capacity enhancing and beneficial subsidies helping fisheries to ensure sustainability. However, Vivas (2017) argues that subsidies create incentives to deplete resources faster.

It is believed that employment security and social security can be achieved by reducing deprivation or vulnerability with the help of subsidies, Kurien (2006). Subsidies and state intervention are essential for the

PURSE-SEINE FISHING IN GOA: A COST BENEFIT ANALYSIS

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Abstract: This study explores the economic performance of the mechanized fishing vessels (purse-seiners) as these contribute to the fishing industry of Goa. The costs and profit analysis of mechanized fishing vessels (purse-seines) help the fishers to understand whether they can attain profits despite high operating costs. The primary data was collected from 73 respondents owning purse-seine through pre-tested interview schedule using random sampling method on three jetties in Goa from August 2016-17. The present study was carried out to analyze the inputs of factors of production used which will give maximum output. The Cobb Douglas production function approach was used to find out the most influential variables influencing the earnings from fish catch. The production function analysis using Cobb-Douglas model indicated that there was ample scope for the respondents to enhance the net profit from purse-seine business at all jetties in Goa by increasing the number of fishing hours, increasing the input variables such as enhancing fuel utilization and increasing number of skilled labourers. The findings of the study suggest that the medium and large sized vessels in Goa are economically and financially viable and generate reasonable revenue to cover fixed and variable costs. Purse-seine fishing business has improved the socio-economic status of the fishermen in Goa. The purse-seine fishing activity is capable of creating additional employment, through Government support, through Fisheries department in augmenting income and improving the standard of living of the purse-seine owners in Goa.

Index Terms : Purse-seiners, Fishing business, Mechanized fishing vessels in Goa

I. INTRODUCTION

Purse-seine, an important bulk catching method was first evolved in the Atlantic Coast during the last quarter of the 19th century and in India it was initiated by the Indo-Norwegian Project in 1954 and the operations on commercial lines were taken up from 1976 onwards (Hameed & Mukundan, 1991). Purse-seining was started in Goa on an experimental basis in 1957 when the union territory of Goa was under the Portuguese rule (Desai, Sharangdhar, & Mohite, 2016). However, it was successfully commercialized in Goa in 1964, with only two purse-seiners under operation. Purse-seining is a method to capture large shoals of demersal fish such as prawns and pelagic fish close to the surface such as sardines, mackerals, tuna, anchovies, herring, salmon by encircling them with a large purse-seine net (Kamble, Chaudhari, Shirdhankar, & Markad, 2013). The purse-seine vessels are equipped with purse-seine nets as well as dingy boats and hence they are called as purse-seiners. During 1991-1992, there were 225 purse-seiners in Goa and the total marine fish landings of Goa was estimated at about 96,000 tonnes, of which the purse-seine contribution was about 75% of the marine fish landings (Panikkar, Sehara, & Kanakkan, 1994). The mechanized sector in Goa contributes to 76% of the marine production. In 2016-17 there were 301 purse-seine vessels operating on Goa's coast. In Goa, Purse-seining is carried out on three jetties viz. Cutbona, Malim and Mormugao (Vasco). Purse-seining is carried in Goa throughout the fishing season, from August to May. However, 1st June to 31st July is observed as fishing ban of 61 days, as per Government rules in Goa. The activities are intense during August to November when oil sardines and Indian mackerels are available in large shoals.

Objectives: The specific objectives of the study are:

1. To estimate the costs and profitability among medium and large size purse-seine vessels from purse-seine fishing activities in Goa.
2. To study the impact of input of factors of production on the earnings from fish catch.

The costs and profit analysis of mechanized fishing vessels (purse-seines) help the fishers to understand whether they can attain profits despite high operating costs. Another research

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Analysis of Capital Investments, Costs and Profits of TrawlingFishing Business inGoa

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ABSTRACT

The objective of the present study is to examine the capital investment, operating costs, fixed costs, and profits of trawl fishing business across small size 32-36 feet, medium size 38-45 feetand large sized 46-60 feettrawlersin Goa. This study explores the capital investments, costsand profits of 78 trawler owners in the two districts of Goa using primary data for the entire fishing season August 2016 to May 2017. The statistical tool, one way ANOVA and post hoc test was used to compare the means of the three groups of small, medium and large sized trawlers regarding the capital investments, costs, earnings and profits.The findings of study using ANOVA test revealed that there is variation in capital investments, costs, earnings and profits made by the owners of small, medium and large sized trawlers in Goa.The study reveals that medium and large sized trawlers owners which undertake multi-day deep sea fishing, earned more gross revenue, gross and net profit per trip as compared to small trawlers.The trawl fishing business is capable of creating additional employment, through government support, enhancing income to improve the standard of living of the fishermen in Goa.

Key words: *Capital investment,Gross revenue, Net profit, Subsidy, Trawlers*

1.INTRODUCTION

The coastline of Goa is 104 km which is (1.28% of Indian coast line of 8117 km) with numerous bays and headlands facilitating the production of fish on a large scale.The state of Goa's coastline although small, has significantly helped the people living in the coastal areas in undertaking fishing activity as a source of livelihood. Fish is an important constituent of staple food for 90% of the population of Goa.According to CMFRI, (2016), Goa is the tenth largest fish producing state among the nine marine states in India. As per the CMFRI Marine Census (2010) fisheries population in Goa was 30,225 and active population was 11,944. The

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2. An Analysis of Costs and Profits of Motorized Fishing Business in Goa

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Abstract

This study explores the cost and profit of 140 motorized canoes owners in the two districts of Goa through primary data for the fishing season August 2016 to May 2017. **The present study focuses on assessing the** capital **investment,** operatingcosts, fixed costs, **earnings, and profit of motorized fishing canoes** across the two groups **namely 26-30 feet and 31-38 feetusing 8 and 9.9 horsepower motor engines. The statistical tool, Independent sample t test was used to compare the means of the two groups of canoes regarding the capital investment, costs, earnings and profits. The findings of the study revealed that there is a significant difference in the mean of capital investments, cost, earnings and profits among the 26-30 feet and 31-38 feetcanoes. The canoe owners owning 31-38 feet incurred higher costs and earned more net profits as compared to 26-30 feet canoe owners. The Government of Goa has to retain the existing subsidies on canoes, fishing gears and other equipment and increase them to higher amount for the welfare of the fishermen.**

Key words: Capital investment, costs, earnings and profit.

1. Introduction

The state of Goa's coastline is 104 km, although small, has significantly helped the people living in the coastal areas in undertaking fishing activity as a source of livelihood. According to CMFRI, (2016), Goa is the tenth largest fish producing state among the marine states in India. The marine production of Goa was 1,20,430 tonnes in 2017 as compared to 1,01,053 tonnes in 2016 whereas the inland production was 5,532 tonnes in 2017 as compared to 4,403 tonnes in 2016 (Fisheries Department, Goa, 2017). The share of fisheries sector of Goa to the State Gross Domestic Product was 2.0 % in the year 2015-2016, declined to 0.70% in 2016-17 (Economic survey, Goa, 2017-2018). The Government of Goa permits the fishermen to build